
Non-geostationary satellite systems

Licensing updates

CONSULTATION:

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1. Overview

One of Ofcom's major priorities is getting everyone connected. We want to make sure people and businesses can access key communications services and to improve access to broadband services in the hardest-to-reach locations.

There are a range of terrestrial technologies that can provide broadband services. In addition, satellite broadband can be suited to connecting remote areas which do not have reliable mobile or fixed broadband. To date, the performance of these services has been limited by the time delay (latency) caused by signals travelling the long distance to the satellite and data caps that are commonly imposed. There are relatively few satellite broadband customers in the UK.

There are new broadband satellites systems being developed, which use many satellites in a non-geostationary satellite orbit (NGSO) closer to the Earth than earlier satellites. These offer lower latency and greater capacity. A number of companies are developing these systems (for example Amazon, OneWeb, SpaceX, and Telesat) and we want to enable as many of them as possible to provide services and increase choice for people and businesses in the UK.

NGSO systems are technically more complex than earlier satellite broadband systems as they plan to use many hundreds, if not thousands, of satellites orbiting the Earth. Satellite dishes need to track these satellites as they move across the sky, unlike existing satellite networks where the dishes are fixed pointing at a single satellite which is stationary in the sky.

This means it is more complex for NGSO satellite operators to agree how to operate their networks without causing harmful radio interference to each other. They are required to do this under the International Telecommunication Union (ITU) Radio Regulations, although in many cases these agreements are yet to be concluded. This creates a risk that interference between NGSO networks could cause localised degradation to the quality and reliability of these services.

We therefore propose to update our approach to licensing NGSO systems. In particular, where possible, we want to ensure that that quality of services is not adversely impacted. To do this we are proposing new checks on interference risks when we consider NGSO licence applications, along with greater visibility of those applications, as well as strengthening our ability to deal with harmful interference if it occurs.

We also want to mitigate the risk of earlier systems hindering the deployment of those coming later because of the interference they could cause, and therefore potentially restricting competition. To do this we are proposing new checks on competition when we consider NGSO licence applications.

Proposed licensing updates

The licences affected are:

- **Satellite (Earth Station Network).** These licences allow the use of **NGSO user terminals**, for example the dish and equipment installed at a customer's premises, and must be held by any satellite operator wishing to deliver services in the UK.
- **Satellite (Non-Geostationary Earth Station).** These licences authorise **gateway** earth stations which are large hubs that connect the satellite network to the internet and/or to private networks and cloud services.

The key changes we propose to the **application process** are:

- to include a check that systems being licensed can coexist without degrading consumer services;
- to include a check to guard against any restriction of competition that could arise if granting the licence could prevent subsequent parties entering the market; and
- to publish applications for any licences which we expect to grant and allow a period for comments where stakeholders can provide information regarding interference or competitive impact.

The new licence conditions we propose would:

- require technical cooperation between operators;
- enable us, where required, to manage local cases of interference that are impacting services thereby protecting UK consumers; and
- be included in new licences.

We would expect to update the small number of existing licences accordingly.

If we receive any licence applications during this consultation period, we will not progress them until we have made a decision on the proposed process and licence conditions.

We want to ensure that all relevant satellite equipment would be subject to these updated rules and therefore propose removing an existing licence exemption for certain user terminals (those operating in Ka band).

We recognise the growing significance of these new systems to the space sector more broadly and will be considering this in more detail as part of our Space Sector Spectrum Strategy, to be published in the Autumn. We do not expect this further consideration will impact or remove the need for the changes we are proposing now.

Next steps

The consultation closes on Monday 20th September. Following this consultation, we will confirm and implement the appropriate licensing changes.

The overview section in this document is a simplified high-level summary only. The proposals we are consulting on and our reasoning are set out in the full document

2. Introduction

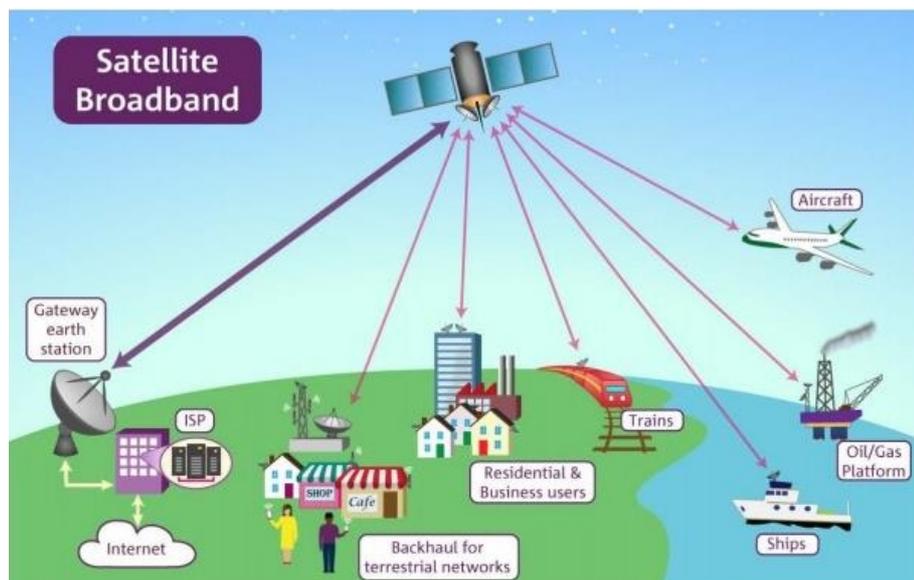
- 2.1 One of Ofcom’s major priorities is getting everyone connected. We want to make sure people and businesses can access key communications services and to improve access to broadband services in the hardest-to-reach locations.
- 2.2 The deployment of new satellite broadband systems operating in non-geostationary orbit (NGSO) is creating new options for people and businesses to access broadband services. However, they may also create new challenges which we need to address to ensure their benefits can be fully realised.
- 2.3 In this document we set out proposals to update our spectrum licensing approach in order to manage the risk of radio interference between NGSO satellite systems, which can impact the quality and viability of services, as well as safeguard competition. We believe these updates are necessary and important now as systems are rolling out.
- 2.4 In the Autumn we will be considering the wider (beyond spectrum licensing) and longer term implications of these systems as part of our Space Sector Spectrum Strategy.
- 2.5 In this section we introduce satellite broadband systems in general and the significance of NGSO systems in particular; set out Ofcom’s duties and role; and outline the rest of this document.

Satellite broadband services

- 2.6 Satellite broadband services have been available for many years and have had a relatively modest take-up in the UK.¹ They can offer near universal levels of coverage of the UK and so can be particularly relevant for delivering broadband services to premises in hard to reach places. Their wide coverage means that they are important for delivering broadband services to ships and aircraft and are also sometimes used to provide backhaul to remote mobile base station sites or to trains.
- 2.7 Compared to terrestrial fixed broadband services, most existing satellite services experience some delay in round trip communications (higher latency) that affects interactive applications like video calls and gaming, and have lower capacity – meaning that users face caps on the amount of data they can use.

¹ There were 28,000 satellite broadband connections in the UK at the end of 2019. Source: The Communications Market 2020 <https://www.ofcom.org.uk/research-and-data/multi-sector-research/cmr/cmr-2020>

Figure 1: Satellite broadband services



- 2.8 These existing systems have used one or more large satellites in geostationary orbit (GSO), at around 36,000 km above the Earth’s equator. This means they remain in a stationary position relative to the Earth (revolving at same speed and direction).
- 2.9 We are now seeing investment in new (Very) High Throughput GSO satellite broadband services which offer the promise of much improved services, although the latency of communications will be similar to existing GSO satellites. These new GSO systems could contribute to the overall broadband landscape in the UK, but their basic architecture and use of spectrum is similar to previous systems, so do not generally raise fundamental new challenges for how we manage spectrum.
- 2.10 In contrast, NGSO satellites are set much closer to the Earth and move in relation to the Earth’s surface. The lower altitudes of these satellites means lower latency services (as less time is taken for a signal to travel to and from the satellite), which can improve the consumer experience, particularly for interactive applications. Additionally, these satellite systems require a fleet or “constellation” of satellites to ensure a continuous connection, with some NGSO broadband networks in Low Earth Orbit (300-2,000 km from the Earth’s surface) proposing to use hundreds or thousands of satellites. More satellites, each with a smaller footprint, means the total capacity of the network can be higher than a single geostationary satellite. Greater capacity means higher speeds can be offered and/or more users can be served.
- 2.11 Table 1 below sets out some of the commercial NGSO systems currently being deployed or planned based on publicly available documentation. This demonstrates that a range of different network architectures and business models are being adopted for these systems.
- 2.12 A number of other constellations are being planned by operators around the world, including in the UK. We have limited ourselves here to the constellations that are either launching or plan to launch services in the next 2-3 years and could serve consumers in the

UK but recognise that there may be other operators in the future. Our proposals take this into account.

Table 1: Commercial NGSO systems

Satellite System	Spectrum for gateways	Spectrum for user links	Initial No. satellites (1 st Gen) ²	Altitude (km)	Latency (ms) ³	Coverage (latitude)	Type of service
Amazon ⁴	Ka band ⁵	Ka band	3236	590 610 630	~30	57N-56S	Direct to home ⁶
Kepler ⁷	Ku band ⁸	Ku band	140	575	20-40	global	IOT ⁹
OneWeb ¹⁰	Ka band	Ku band	648 ¹¹	1100-1200	50	global	Backhaul ¹² /mobility ¹³
SpaceX ¹⁴	Ka band	Ku band	4408	540 550 570	20-40	global	Direct to home
Telesat ¹⁵	Ka band	Ku band	298	1015 1325	50	global	Backhaul /mobility

2.13 The more dynamic nature of NGSO satellite systems introduces new challenges for managing spectrum (discussed in Section 3), which have prompted to us to develop the proposals in this document.

² Designs for 1st generation architecture for these constellations are more certain. More satellites are expected for all these constellations and are indicated in the FCC references below. These may evolve.

³ The latency figures are estimates based on the height of each constellation and the speed of light.

⁴ [FCC Authorizes Kuiper Satellite Constellation | Federal Communications Commission](#) July 30 2020

⁵ Ka band satellite services typically use 18-20 GHz for downlink and 27.5-30 GHz for uplink.

⁶ Direct to home indicates a broadband service sold direct to consumers.

⁷ [FCC Grants Kepler Communications Access to US Market | Federal Communications Commission](#)

⁸ Ku band satellite services typically use 10.7-12.7 GHz for downlink and 14.0-14.5 GHz for uplink.

⁹ IOT denotes “Internet of Things”, i.e. broadband uplink for businesses.

¹⁰ [FCC Grants OneWeb U.S. Market Access for Expanded NGSO Constellation | Federal Communications Commission](#)

¹¹ Size of initial OneWeb constellation: <https://oneweb.world/media-center/oneweb-completes-its-five-to-50-mission>

¹² Backhaul denotes a service provided to broadband and mobile telecommunications companies, helping them to extend their networks into hard to reach areas. This can sometimes include connectivity for towns and cities.

¹³ “Mobility” here denotes a broadband service for air, maritime, rail or road companies, e.g. cruise ships, shipping, airlines.

¹⁴ FCC Ruling on SpaceX Modification, [FCC-21-48A1.pdf](#), April 2021

¹⁵ Telesat modifies its constellation [2378318.pdf \(fcc.report\)](#)

Ofcom's role and objectives

- 2.14 Ofcom has core legal functions and duties that relate to the control of harmful radio interference. Wireless communication relies on use of the radio spectrum, but if every wireless device could transmit in an uncontrolled way, they would cause harmful interference to others, degrading or preventing communications altogether. Therefore, some form of regulation of spectrum use is beneficial to reduce the likelihood of interference.
- 2.15 There are two levels to the regulation of spectrum use - radio interference that arises internationally and radio interference within the UK. Ofcom is active at both levels.
- 2.16 However, it is the interference emanating from radio equipment and radio systems within the UK and hence the **regulation of radio frequencies under the UK regulatory framework**, which is the focus of the document and the proposals within it. These proposals sit alongside and do not change or replace our international responsibilities.

Regulation of radio interference that arises internationally – the ITU

- 2.17 In order to stop radio signals from one country disrupting signals in another country there is a world-wide international regulatory regime. This is governed by the International Telecommunications Union (ITU) and a body of international treaty rules contained in the ITU's Constitution, Convention and "Radio Regulations". These rules aim to achieve efficient use of the radio frequencies internationally, since radio frequencies are a scarce resource. This is done by establishing an order of precedence as to which radio signals travelling across international borders prevail over other signals if harmful radio interference arises. Interference can potentially arise across international land and sea borders from a large variety of radio systems, including for example television broadcasting and mobile phone networks.
- 2.18 Since satellites in space transmit or broadcast down to multiple countries on earth, the ITU also has a system for registering internationally in its master register the orbital position and radio frequencies used by those satellites. This is essentially a first come first served principle, whereby later registrations must coordinate with prior registrations (known as filings). However, regardless of the date of their filing, all operators need to make every effort to accommodate these coordination discussions, working in good faith to reach coordination agreements.
- 2.19 Within the UK, Ofcom is tasked with making satellite filings to the ITU on behalf of companies wishing to launch satellites. Ofcom makes and manages the process for satellite filings for companies or other organisations registered in the UK, the British Overseas Territories, the Channel Islands and the Isle of Man.¹⁶ In particular, we are responsible for a number of NGSO satellite filings with the ITU.

¹⁶ Ofcom's satellite filing procedures are set out at https://www.ofcom.org.uk/data/assets/pdf_file/0022/140926/new-procedures-1.pdf

- 2.20 Ofcom’s role can involve supporting satellite operators with their ITU filings and taking such action as may be necessary to protect UK filings. This can include assisting with co-ordinating their systems with other operators and administrations and helping to resolve disputes where necessary. Ofcom is also responsible for representing the UK in international forums that deal with spectrum, including at the ITU and European Conference of Postal and Telecommunications Administrations (CEPT). In relation to satellites, we help to develop international rules that support the efficient use of spectrum by satellite networks, including by NGSO systems. For example, we supported new rules for the ‘Bringing into Use’ of non-geostationary satellites systems that were agreed at the ITU’s World Radio Conference of 2019.
- 2.21 Ofcom’s legal functions and duties for these activities derive from section 22 of the Communications Act 2003.¹⁷

Regulation of radio interference that arises within the UK

- 2.22 There are a broad range of general objectives for Ofcom as set out in the Communications Act 2003 including (in section 3) to further the interests of citizens and consumers, where appropriate by promoting competition and to secure the optimal use of the radio spectrum.
- 2.23 Ofcom is tasked with granting licences to users of radio equipment under the Wireless Telegraphy Act 2006 (the “2006 Act”). Transmission or reception of radio signals is unlawful and a criminal offence under the 2006 Act, unless it is done in accordance with an authorisation contained in a “wireless telegraphy” licence granted by Ofcom or set out in a licence exemption (contained in a statutory instrument) made by Ofcom. These licences and exemptions aim to segment users of the radio spectrum in terms of frequency, geographic location or time so as to avoid harmful interference.
- 2.24 Key spectrum management objectives and duties are contained in the 2006 Act. Key objectives are to achieve optimal (and efficient) use of the scarce resource of radio spectrum, and to promote competition. There are also specific legislative requirements which relate to granting licences and changing (varying) them.
- 2.25 A key part of the UK framework of rules for spectrum licensing is set out in in section 3 of the 2006 Act. In carrying out our spectrum functions we have a duty under that section to have regard, in particular, to:
- a) the extent to which the spectrum is available for use, or further use, for wireless telegraphy;
 - b) the demand for use of that spectrum for wireless telegraphy; and
 - c) the demand that is likely to arise in future for such use.

¹⁷ (The judgment by Mr Justice Goldring in the case of the Government of Bermuda v Office of Communications & Ors [2008] EWHC 2009 (Admin) (13 August 2008) gives a particularly clear explanation and summary of the legislative background. It is available on www.balli.org.)

- 2.26 We also have a duty to have regard, in particular, to the desirability of promoting:
- a) the efficient management and use of the spectrum for wireless telegraphy;
 - b) the economic and other benefits that may arise from the use of wireless telegraphy;
 - c) the development of innovative services; and
 - d) competition in the provision of electronic communications services.

Our objectives in relation to NGSO systems

- 2.27 In our [Plan of Work for 2021/22](#) we set out our strategic priority to get everyone connected, including to improve access to broadband services in the hardest-to-reach locations. Given the potential role that new NGSO systems could play in advancing this aim, our objective is to enable as many of them as possible to provide services and increase choice for people and businesses in the UK.
- 2.28 In the rest of this document we set out the proposed updates to our spectrum licensing processes and conditions which we believe are necessary to support this objective.

Suspension of licensing process

- 2.29 Given that the licence terms and process for issuing NGSO licences are the subjects of this consultation, we will not process applications for NGSO licences received during the consultation period. We will process any such applications according to the decisions we make following this consultation.
- 2.30 At the time of publication, we were in the final stage of issuing one Satellite (Non-Geostationary Earth Station) licence. We decided to continue to issue this licence, noting that it has already followed an open process similar to the one we are proposing here through the Isle of Man administration, and that it would be subject to variation to include the new licence terms as we may determine following this consultation.

Looking ahead

- 2.31 The nature of NGSO systems will continue to develop, with future generations already being planned with more satellites, new frequency bands, greater use of inter-satellite links etc. We are therefore also starting to consider future scenarios and use cases for NGSO systems. These changes could bring further benefits to people and businesses and/or introduce additional or different regulatory challenges.
- 2.32 We will consider these wider and longer-term implications of NGSO systems as part of our forthcoming Space Sector Spectrum Strategy. We do not expect this further consideration will impact the need for the changes we are proposing now.

Next steps

2.33 The consultation closes on Monday 20th September. Following this consultation, we will confirm and implement the appropriate licensing changes.

Rest of this document

Background and rationale

2.34 **Section 3** explains how new interference management challenges associated with NGSO systems could lead to adverse impacts on users and competition, and identifies how we propose to mitigate those risks.

2.35 **Annex 1** provides additional background information on how satellite broadband systems use spectrum.

Detail of proposals

2.36 Sections 4 to 7 set out the detail of our proposals:

- **Section 4** sets out the new process we are proposing for NGSO licence applications.
- **Sections 5 and 6** set out our proposals for new conditions in the licences authorising NGSO user terminals (referred to as **network licences** in this document) and NGSO gateway earth stations (referred to as **gateway licences** in this document). The new licence conditions are listed in Annex 2 and 3.
- **Section 7** sets out our proposal to remove licence exemptions for Ka band terminals so that these will need to operate under the same type of licence as Ku band terminals.

3. New challenges raised by NGSO systems and our proposed approach

3.1 In this section we explain:

- the challenges that NGSO systems face in managing interference between different systems;
- the potential impact of interference on the provision of services to users;
- the role of the ITU framework in dealing with those challenges and impacts;
- the possible implications for competition between NGSO systems; and
- how we propose to mitigate the risks to service quality and competition.

NGSO systems introduce new challenges for managing interference

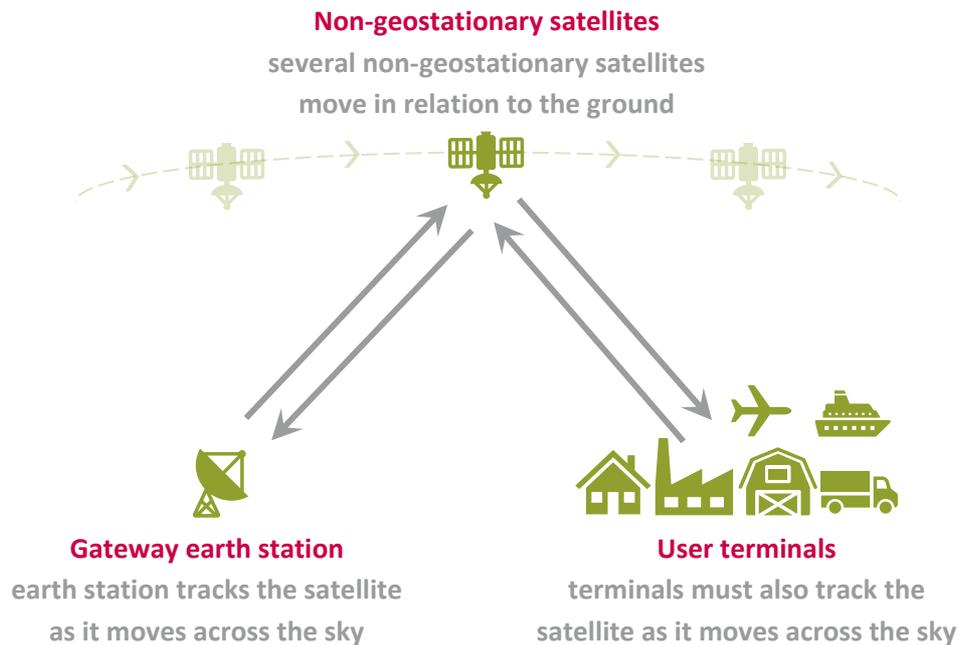
3.2 NGSO satellites move around the Earth along predefined “orbital planes”. There may be hundreds or thousands of satellites strategically spaced so that, from any point on the surface, at least one satellite is always visible on a direct line of sight. To achieve a continuous connection, gateway earth stations and user terminals are required to track these satellites as they move across the sky, transmitting and receiving information as they do so.

3.3 In contrast the satellite dishes used for GSO satellites systems can remain fixed pointing at a single point in the sky. See Annex 1 for background on satellite broadband systems in general and spectrum use by GSO systems in particular.

3.4 The key elements of an NGSO system are shown in Figure 2 below. Our approach to licensing each of these elements is:

- **User terminals**, typically comprising a small antenna and associated equipment, are authorised by a “Satellite (Earth Station Network)” licence. This licence is referred to in the remainder of this document as a “**network licence**”.
- **Gateway earth stations**, typically large hubs that connect the satellite system to the internet and/or to private networks are authorised by a Satellite (Non-Geostationary Earth Station) licence. This licence is referred to in the remainder of this document as a “**gateway licence**”.
- **Satellites**. Ofcom does not issue licences for radio transmissions by satellites in space. As discussed in section 2, spectrum use by satellites is coordinated by the ITU.

Figure 2: Key elements of a NGSO satellite system



- 3.5 Given the large number of NGSO satellites that are being deployed by operators, there is a risk of satellites from two different operators appearing to be in the same part of the sky (see Figures 3 and 4). Interference between different systems can occur as they line up in the sky. This is referred to as “in-line event”. This interference can arise on:
- **User links** between the satellite user terminals and the satellite – both in uplink and downlink directions (Figure 3).
 - **Gateway links** between the satellite gateway earth stations and the satellite – both in uplink and downlink directions (Figure 4).
- 3.6 This interference can disrupt the connection between an earth station and the satellite it connects with, impacting the service provided to users.

Figure 3: Interference between two NGSO systems due to in-line events: User link

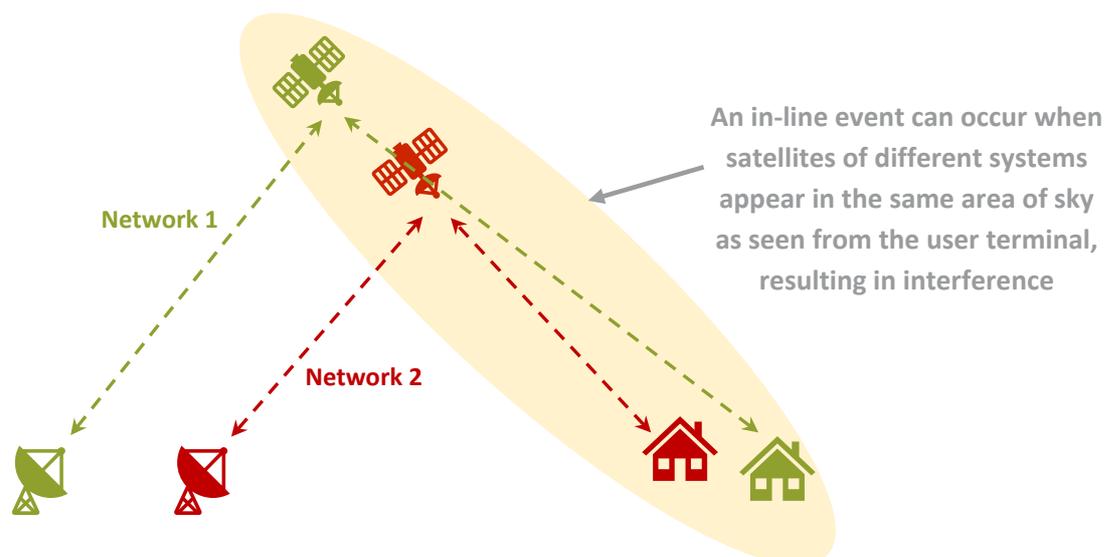
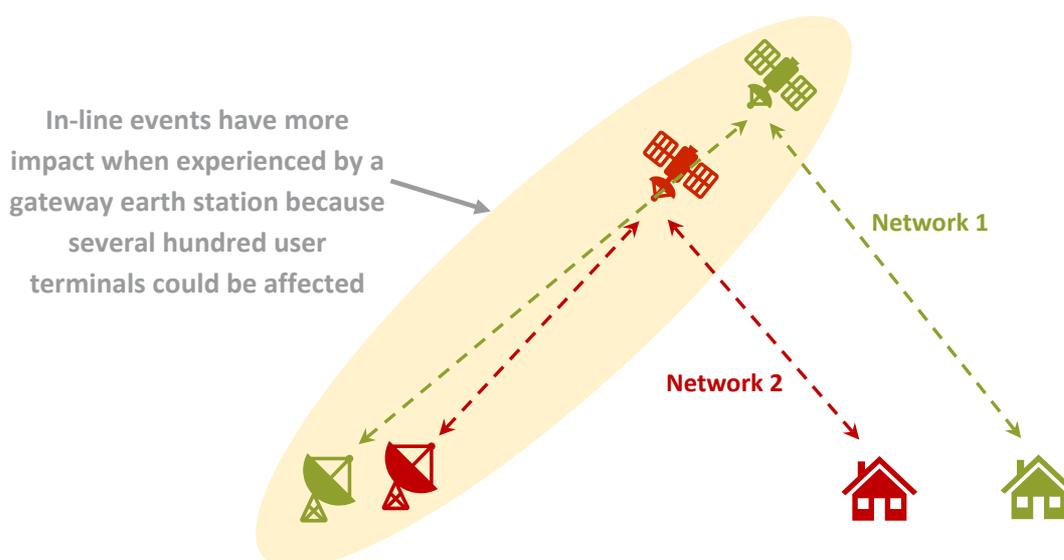


Figure 4: Interference between two NGSO systems due to in-line events: Gateway link



Impact of interference on services

- 3.7 Since NGSO satellites are moving relative to each other and relative to the ground, in-line events may individually only be brief, maybe a few seconds. However, if an in-line event occurs and causes interference, it may take longer for the terminal to reconnect to the network. The interference could continue to repeat over time, reoccurring in a regular pattern which will depend on the orbits of the respective systems.
- 3.8 The exact nature of the disruption to the user will depend on a number of factors, including the design of each system and the robustness of user equipment. The practical

impact for users could be on their ability to send and/or receive data, depending on the nature of the interference and the nature of the service being provided. For example:

- If a user is sending data (e.g. uploading a file) it may not get to its final destination as intended or be delayed, due to harmful interference affecting the satellite-to-gateway downlink and/or the user-to-satellite uplink.
- Conversely if the user is wanting to download data (e.g. watch a videostream) this may be disrupted by interference to the satellite to user downlink and/or gateway to satellite uplink.

3.9 Because the provision of broadband internet service to users depends on both the user link and gateway link, interference arising on any of these links can disrupt or degrade user's internet connection. However, the impact of interference on gateway links would be much greater than on individual user links as each gateway provides connectivity for many users (perhaps hundreds or thousands of users depending on the design of the system), so a loss of connection due to interference at the gateway will be experienced more widely across the network.

Role of the ITU Radio Regulations

3.10 The potential for harmful interference between different satellite systems is usually managed by operators cooperating with each other under the ITU satellite coordination procedures. We continue to support this process.

3.11 However, coordination between NGSO systems is proving to be more challenging due to the dynamic nature of these systems (discussed above), combined with operators having differing rates of deployment (some operators holding older filings will not deploy their systems for a few years) and changing their architecture over time. We are therefore concerned that NGSO satellite services could be deployed before an appropriate level of coordination has been possible with other operators.

3.12 We strongly encourage UK filed networks to progress coordination and will take action to facilitate that. However, we do not have a role in ITU coordination between foreign filed operators that are providing services in the UK.

3.13 In addition, cases of harmful interference can be dealt with through the ITU framework for managing satellite filings. Where a later system causes interference to one which was filed earlier, and coordination has not been completed, the administration responsible for the later filing should take steps to "immediately eliminate" the interference.¹⁸

3.14 However, these procedures only apply in cases where the filings are from different administrations, and the UK would only be able to initiate it if the more senior filing was a UK filing. In addition, this process may not resolve the interference sufficiently quickly to

¹⁸ Systems may be entered into the Master International Frequency Register under No.11.41 of the Radio Regulations; however, they shall operate on a non-interference non-protection basis with respect to those earlier systems where coordination has not been achieved. If harmful interference is caused by the later system then under No. 11.42 of the Radio Regulations the administration responsible needs to "immediately eliminate" it.

mitigate any negative impacts. For example, disputes may be referred to the ITU Radio Regulation Board that meets three times a year, during which time there may be sustained impact.

- 3.15 Therefore, we do not think we can solely rely on the ITU framework to effectively deal with all concerns impacting NGSO services provided in the UK.

Implications for competition

- 3.16 In addition to the direct disruption caused to broadband services, the challenges of managing interference between NGSO systems could have implications for competition. The issues play out slightly differently for gateway and user links, and so we discuss these separately below.

Gateways

- 3.17 We understand that NGSO gateways are likely to require large minimum separation distances (for example 10s of kilometres or more) from the gateways of other systems, in order to avoid harmful interference, even if there is agreement on coordination of the satellite systems as a whole.¹⁹ This results in a need for there to be some cooperation between operators and/or a process for coordinating the location of gateway earth stations within a country, in order to avoid sites being located too closely together.
- 3.18 This contrasts with GSO gateway earth stations, as multiple GSO gateways can be located on a single site, each communicating with a different satellite system in a different orbital location, without causing harmful interference to each other (see Annex 1). This means that GSO operators do not have to be concerned about where other GSO operators are locating their gateway earth stations.
- 3.19 If the separation distances needed between NGSO gateways were to be very large (say much greater than 100 km) and/or demand for sites were sufficiently high, then this introduces the possibility of a scarcity of sites within the UK. This scarcity could contribute to competition being restricted if enough sites were acquired by a single player (or concentrated number of players) such that other operators requiring UK sited gateways could not enter the market.
- 3.20 At present we do not think there is a significant risk of this scarcity materially constraining the deployment of NGSO systems in the UK. This is because not all systems will technically depend on a gateway in the UK in order to be able to offer services in the UK, and our understanding is that those that do would need only a limited number of gateways (depending on their system architecture). Based on the current information that operators have provided to us about their plans for gateways, we believe that sufficient sites will be available.

¹⁹ The requirement for a minimum separation distance can in principle be avoided for NGSO user terminals if there is a choice of satellites for the terminal to point at, thus avoiding the possibility of an in-line event. Gateways may not have a choice of satellites with which they need to communicate, although this will depend on the design of the system.

- 3.21 However, scarcity of sites could be (artificially) exacerbated if the separation distance needed to protect a gateway were to be very large as a result of unrealistic levels of protection being claimed; and/or if operators apply for gateway licences that they never actually use for a real system.
- 3.22 In addition, there are uncertainties over how the design of NGSO systems will develop in the future, with technology and system architecture changes potentially increasing or decreasing gateway requirements. We will continue to engage with stakeholders (including through our Space Sector Spectrum Strategy consultation in the Autumn) to understand their future plans for future generations of NGSO systems.

User terminals

- 3.23 A lack of agreement over how user terminals of different systems can coexist in the same area and band could restrict competition as a result of earlier deployed systems hindering later ones.
- 3.24 Once one operator starts deploying user terminals, other operators wishing to launch services using the same band may expect to experience harmful interference from the existing user terminals. In the worst case this could mean that the quality of their broadband services would not be sufficiently reliable in order to enter the market. Nonetheless, the established player could have an incentive to cooperate given that the interference is likely to be mutual, i.e. their services could be degraded as well.

How we propose to mitigate risks to service quality and competition

- 3.25 Our proposals to address the above risks to service quality and competition have four elements: encouraging cooperation; managing interference, supporting competition; and acting openly.

Encouraging cooperation

- 3.26 **Cooperation between operators** is key to avoiding the risk of **disruption to NGSO broadband users**. As noted above, there are obligations to coordinate under the ITU Radio Regulations (where operators are filed through different administrations), but our international role is limited to encouraging coordination by or with UK filed systems. In addition, ITU coordination does not tend to deal with the specific siting of gateway earth stations within a country.
- 3.27 We are therefore proposing to introduce an additional explicit **licence condition requiring NGSO licensees to cooperate** so they can co-exist and operate within the UK without causing harmful radio interference to each other. We are proposing to introduce this condition into NGSO network licences, as this licence should be held by the entity responsible for coordinating the entire system. **Section 5 on network licences** includes this proposal.

- 3.28 For the avoidance of doubt, this would complement (and not change or replace) existing obligations that licensees may have to coordinate under ITU coordination procedures.
- 3.29 Cooperation between operators in relation to the **siting of gateway earth stations** can also be improved by us **publishing applications for new licences** before granting them. This should assist Ofcom and operators in identifying potential interference risks and taking the steps required to mitigate these. For example, the additional transparency could alert other operators who are considering establishing a site, or nearby sites, for their own gateway, to potential for interference issues. **Section 4** sets out our proposals for **updating our licensing process** to include publication of licence applications.

Managing interference

- 3.30 We are proposing two measures to manage the risk of interference adversely impacting NGSO broadband services. They seek to avoid this situation arising and to deal with it if it does. We would:
- a) Introduce **checks when we issue new NGSO licences** so that these are only granted if all systems (existing and new) are able to coexist and provide services to end users. These checks are explained in **Section 4** where we set out the new process.
 - b) Introduce **new conditions** into NGSO licences enabling us to **take action to resolve degradation to services** if this were to occur at a particular location or location(s) in the UK. These conditions would be included in **network licences (see Section 5)** and **gateway licences (see Section 6)**.
- 3.31 We are also proposing changes (in Section 7) that will ensure that operators **with Ka band user terminals will need to hold a network licence**, and so would be subject to the same conditions as those with Ku band user terminals (who already need to hold a network licence).

Supporting competition

- 3.32 As discussed above, there is potential for the deployment of NGSO gateways and user terminals to create competition concerns by introducing barriers for future systems.
- 3.33 To guard against these risks we are proposing to introduce a **competition check into our process (see Section 4)** for issuing new NGSO licences for gateways and user terminals. This check would need to take into account of the technical constraints that the gateway or user terminals could create on future licensees. If they need too much protection or have too little flexibility, then they would be more likely to restrict competition from emerging.
- 3.34 Our proposals above to encourage operators to cooperate and to manage interference risks will also support competition by enabling multiple systems to coexist.
- 3.35 In addition, the risk of **scarcity** of gateway sites can be reduced by introducing a requirement for gateway licensees to **commence and maintain transmissions within 12 months**.

An open and transparent process

- 3.36 The ability for different NGSO satellite systems to coexist and the impact on competition are matters on which stakeholders other than the applicant would legitimately have an interest and relevant information. Therefore, we are proposing a **period for stakeholders to comment** on new NGSO licence applications that Ofcom intends to grant. As noted above the publication of applications could also support cooperation between operators with regard to locating gateway sites.

Consultation questions

Question 1: Do you have any comments on our assessment of the interference challenges raised by NGSO systems and their potential impact on a) service quality; and b) competition?

Question 2: Do you have any comments on our approach to dealing with the interference challenges raised by NGSO systems?

4. Updated licensing process for NGSO network and gateway licences

Introduction

- 4.1 To date we have dealt with applications for new NGSO gateway and network licences in the order in which we receive them, and issue licences following routine checks, including on coexistence with terrestrial services (where relevant). We rely on satellite operators to coordinate their systems as appropriate but do not check this as part of the licensing process.
- 4.2 In order to help manage the risks discussed in section 3, and to do so in a transparent way, we are proposing to update our process for issuing NGSO earth station licences. This would introduce a short period for comments on new licence applications, as well as variations (for example to add new frequencies or antennae) to issued licences.
- 4.3 This new process would be complemented by new licence conditions for network and gateway licences which we propose in the next two sections.

Objectives and criteria for proposed updated licensing process

- 4.4 Two key objectives identified in the previous section are to manage interference and support competition. We discuss these objectives and the corresponding criteria we are proposing for our updated licensing process below, as well as noting the relationship between our processing of licence applications and our responsibilities under the ITU Radio Regulations.

Managing interference

- 4.5 In issuing new licences our aim is to be satisfied that it is reasonable for all authorised systems to be able to coexist (in bands they are using in common), such that they are all able to provide good quality services to their users. Our intention is not to specify how this coexistence should be achieved, as we believe this remains best determined by the companies involved, including through the established ITU process for coordinating satellite systems.
- 4.6 This means that the actions that operators take to coexist with each other could involve reasonable mitigations and adjustments by any or all parties, including existing system operators agreeing to take reasonable action to accommodate new ones as a result of an ITU coordination agreement.
- 4.7 We are proposing to continue considering licence applications in the order we receive them, but that earlier licence applications should not have the ability to block later systems if it is reasonable for them to be able to coexist. We propose that in practice this would mean that:

- a) **For gateways operating under a NGSO earth station licence:** We would want to avoid authorising new gateway earth stations that are located too close to existing gateway earth stations such that (even with reasonable mitigations by either party) one or both would be unable to operate and support services to end users without experiencing harmful interference.
 - b) **For earth station network licence authorising user terminals:** We would want NGSO terminals authorised under such a licence to be able to coexist with other authorised NGSO systems (gateways or terminals), taking account of the ability of either party to make reasonable efforts to mitigate interference.
- 4.8 In undertaking these assessments, we would take into account information which previous applicants have provided about the technical flexibility of their system (see competition discussion below).
- 4.9 Note that in the following section we also propose an obligation for all holders of network licences to cooperate with other licensees to ensure that the NGSO system they are responsible for can coexist with others authorised in the same band.

Competition

- 4.10 Our aim is to reduce the risk that issuing the licence(s) applied for (if combined with other licences held or applied for by the applicant) would restrict competition. In particular, we would be concerned if issuing the licence(s) had the effect of creating barriers to competition emerging in the market. The implications for gateway and network licences are discussed below.

For gateway licences

- 4.11 As noted in section 3, gateway earth stations of different NGSO systems may require large separation distances, for example 10s of kilometres or more, in order to avoid harmful interference, which has the potential to be a constraint on the number of licences that could be accommodated in the UK.
- 4.12 The number of gateway earth stations needed in the UK, if any, in order to offer UK services will vary from system to system. Some will not technically require a UK gateway as they will rely on a gateway in nearby countries or may require one at most. Others may require a small number say 4 or 5. Given this, and the range of options for siting earth stations across the UK, we propose that it is reasonable to continue to issue licences as people request them provided that we have the opportunity to consider/take account of any competition concerns arising from an application (for example, if one or a number of operators was seeking to acquire licences for a large number of sites) which would limit options for others to the extent they could not enter the market.
- 4.13 In considering whether acquisition of additional gateways could restrict competition, we propose that a relevant factor would be the extent to which the satellite system has the flexibility to accommodate other operators deploying gateways near to them in the future. For example, systems which are likely to require other gateways to be at least 200 km

away from its own gateways (whilst recognising this is a function of both systems) would likely raise greater competition concerns than those that are flexible enough to accommodate others much closer.

For network licences

- 4.14 A network licence is necessary for an operator to deploy user terminals in the UK.²⁰ Therefore issuing a new network licence supports market entry, and has the potential, if a service is deployed, to support greater competition (assuming as discussed above that it can coexist with other authorised systems).
- 4.15 Therefore, competition concerns would primarily arise from the constraints that systems operating under a network licence could impose on subsequent entrants due to the technical barriers to coexistence between systems (e.g. due to lack of flexibility in the design of systems). In particular in a market that was concentrated, if there was limited prospect of the licensee system and future systems (applicants) being able to technically coexist, then this could form a barrier to future entry to the market.
- 4.16 As a result, we are proposing that a key piece of information that applicants should provide when applying for a network licence is credible evidence about the technical ability for their system and future systems to coexist. This would include evidence about the flexibility of their system and/or what reasonable steps new licensees could easily undertake to protect them. This information would also be used when assessing whether it is reasonable for new applications and existing services to coexist, to understand the reasonableness of mitigations being undertaken by existing licensees.

Order of processing

- 4.17 We believe that each of these objectives can be achieved whilst continuing to process licence applications in the order that we receive them. As a result we are proposing to consider each (complete) application in the context of existing issued licences and earlier applications.
- 4.18 However, and for the avoidance of doubt, this does not affect our support for operators undertaking coordination of their satellite networks in accordance with the ITU Radio Regulations. Successful coordination in accordance with ITU coordination procedures, such that multiple NGSO systems can coexist and compete in the UK, supports our national licensing objectives.

Overview of process

- 4.19 In light of the objectives above, we propose to introduce a new process for considering non-geostationary licence applications, which will provide an opportunity for stakeholders to comment. In summary, we propose to:

²⁰ See our proposals in Section 7 to bring Ka band user terminals in line with Ku band user terminals

- Undertake preliminary coexistence and competition checks upon receiving an application.
- Publish details of the licence applications we intend to grant (as well as those where we require additional information) on our website to provide a short period for stakeholders to comment.
- Review the comments, seeking further information and undertaking our own analysis as appropriate, and decide whether or not to issue the licence.

4.20 An overview of the proposed new process for obtaining a licence is shown in Figure 5 below and further explanation is provided in the following sub-sections.

Figure 5: Overview of the proposed new process



Apply for a licence

4.21 The proposed new process would apply to applications for new licences or applications to amend existing licences for the following two licence products:

- Satellite (Non-Geostationary Earth Station) licence (referred to as the ‘gateway’ licence in this document)
- Satellite (Earth Station Network) licence – for non-geostationary earth stations only (referred to as the ‘network’ licence in this document)

4.22 Each licence application would have its own separate process which would be initiated when Ofcom receives the licence application. Applicants would need to submit the relevant licence application form(s), along with the following additional information:

- **Coexistence with other NGSO systems.** Applicants should demonstrate how coexistence is possible between their networks and:
 - Existing non-geostationary systems that are already licensed in the UK.
 - Non-geostationary systems that have applied for a licence and whose application has been published for comment.
 - Applicants can demonstrate coexistence preferably by stating that an agreement with the other party already exists, or if that is not available providing a technical coexistence analysis.²¹ In the former case, Ofcom will check with the other parties that the agreement exists.
- **Ability to coexist with future NGSO systems.** As noted above, the competitive impact of issuing a new licence will depend on the ability of the system to be able to coexist with future networks. Therefore, the applicant should state what flexibility their system has to coexist with future networks. These should include the measures they would be able to put in place if another network comes along in the future, and the expected benefits of such measures; it could also suggest measures future networks could reasonably be expected to put in place in order to coexist.
- **Competitive impact.** Optionally, applicants would be able to provide information on the competitive impact of issuing the licence (combined with other licences held or applied for by the applicant). This may refer to their ability to coexist with other systems.
- **Ability to comply with NGSO conditions.** The applicant would state that they have the ability to comply with the terms of the licence, in particular the new NGSO conditions that we are proposing. Sections 5 and 6 set out the conditions we are proposing to include and the responsibilities these imply for the licence holder. In particular:
 - Those applying for a **network licence** – we would expect them to have control over the whole satellite network (including the associated user terminals and gateway earth stations) and the ability to negotiate and agree coexistence arrangements with other licence holders, so that they are able to comply with the conditions associated with that licence.
 - Those applying for a **gateway licence** – we would expect them to have control over the gateway earth station. In addition, applicants for gateway licences would need to state that they are operating with a satellite system for which we have issued a network licence (and state the licence number and licensee) to an appropriate entity. This would be to ensure that there is an entity with the responsibility and ability to agree coexistence for the whole satellite system (including the gateway).

²¹ As a reference, applicants may consider the type of technical analysis usually carried out during bilateral coordination discussions, e.g. comparison of the statistical distribution of the interference-to-noise ratio (I/N), impact on average spectral efficiency and availability, etc.

- 4.23 The licensee may indicate that some of the additional information requested is commercially confidential if they do not wish Ofcom to publish this alongside their application.
- 4.24 If the standard licence application form(s) were not completed correctly, or if the additional information set out above was not submitted, Ofcom would ask the applicant to provide additional information where appropriate and to re-submit their application.

Ofcom initial assessment

- 4.25 Once we have confirmed that the application is complete, we propose to make an initial assessment of the material submitted, in line with the aims and objectives discussed above, to consider the ability of existing licensees and the new applicant to coexist, and whether issuing the licence could restrict competition.
- 4.26 If we consider that coexistence between existing licensees and the applicant is likely to be possible and there does not appear to be a risk of a restriction of competition, we intend to publish the application and our intention to grant it. If we had some concerns or uncertainties about the application in relation to coexistence or competition, we may also decide to publish it so that we can seek further information from stakeholders before taking a decision. In both these cases the proposed commenting period described below would commence. Alternatively, if we had concerns we propose to seek further information from the applicant and/or ask them to modify and re-submit their application. This may result in the application not progressing beyond the initial assessment if we were unsatisfied regarding coexistence and/or competitive impact.

Applications to vary existing licences

- 4.27 If the application is to vary an existing gateway licence, we would assess whether the changes would increase the interference environment that is already imposed by the gateway site. For example, if the application adds additional antennas operating within the same frequencies already authorised by the licence, we may decide there is no impact and therefore issue the licence without inviting public comments. On the other hand, if we decide that an application to vary an existing gateway licence changes the interference environment, for example if there are additional frequencies or increased transmit power, then we intend to proceed with the proposed new licensing process including the commenting period.

Commenting period

- 4.28 Under these proposals, once Ofcom publishes details of a licence application, a short commenting period will begin, allowing anyone to make representations on matters related to granting the licence. The commenting period would normally run for four weeks. Each licence application would have its own separate commenting period, so it is possible there may be multiple commenting periods running in parallel.

- 4.29 If we publish an application for comments, we intend to provide a response form and the closing date for responses. We would also notify stakeholders that we have published a licence application.
- 4.30 We would expect the response form to provide specific questions that stakeholders should answer with respect to the licence application, including the feasibility of coexistence and the impact on competition. As we do for other Ofcom consultations, we would publish responses in full on our website unless a respondent specifies that all or parts of their response is confidential.

Ofcom decision

- 4.31 Following the end of the proposed commenting period, Ofcom would review the responses and publish a decision on whether or not to grant a licence. As part of this process, we may wish to make additional assessments on matters related to technical coexistence and competition.
- 4.32 We would then publish our decision setting out whether or not we will grant a licence and the reasons for making the decision.

Timeline

- 4.33 Under these proposals, we would aim to follow the indicative timeline shown in Figure 5, however we may need to extend these timings in certain situations, for example if the coexistence and competition assessment is particularly complex or if we were to receive multiple licence applications in quick succession. If we need to allow a longer commenting period, we would do this by setting an appropriate closing date when we publish the application for responses.

Consultation question

Question 3: Do you have any comments on the proposed updates to our process for NGSO gateway and network licences?

5. Proposed updates to existing and new NGSO network licences

- 5.1 We are proposing to update the Satellite (Earth Station Network) licence – for non-geostationary earth stations only, to include additional terms. As explained in Section 3 and in Annex 1 these licences are used to authorise spectrum use by NGSO user terminals.
- 5.2 The new terms would be included as standard terms of the Earth Station Network licence issued to future applicants. We would also amend existing Earth Station Network licences to include the updated terms.

Existing licences that we propose to amend

- 5.3 There are three existing earth station network licences for NGSO use which are held by:
- Network Access Associates Ltd (UK) (trading under the name “OneWeb”)
 - Kepler Communications Inc.
 - STARLINK INTERNET SERVICES LIMITED (Starlink satellite broadband services are provided by SpaceX)
- 5.4 More details on these licences can be found in the public Wireless Telegraphy Register on our [Spectrum information portal](#).

Proposed updates to existing and new licences

- 5.5 For the reasons set out in section 3 and below, we are proposing to update the licence conditions for NGSO licences to:
- a) Require NGSO licensees to cooperate with the other NGSO licensees operating in the same frequencies so they can coexist.
 - b) Enable us to require operators to take action in cases of interference between NGSO systems which impacts the provision of services to users in particular location(s) in the UK.

Proposed requirement to cooperate so that NGSO systems can coexist

Draft conditions 1 and 2 for network licence:

Use of frequencies in common and requirement to cooperate

1. The radio frequencies authorised by this Licence must be used in common with other non-GSO satellite systems authorised under wireless telegraphy licences granted by OFCOM. These names of these licensees shall be notified by Ofcom to the Licensee from time to time, and together with the Licensee are described as the “NGSO Licensees”.
2. The Licensee shall cooperate with all NGSO Licensees such that each satellite system (comprising the satellites, earth stations and user terminals) can co-exist and operate within the United Kingdom without causing harmful radio interference to each other, such that network services can be provided to end users.

- 5.6 A number of NGSO satellite systems may be licensed to operate in the UK, and these systems may overlap in some or all of these frequencies that they operate in. The overlapping frequencies may include the bands used for links between satellites and gateway earth stations, and/or the bands used for links between satellites and user terminals.
- 5.7 As already discussed, in order for these systems to operate and provide services to end users in the UK, there needs to be some arrangement for them to be able to coexist in the frequencies that overlap.
- 5.8 Therefore we are proposing to introduce conditions that will require NGSO licensees to cooperate with the other NGSO licensees operating in the same frequencies to enable their systems to coexist, so that each satellite system is able to offer services to end users.
- 5.9 Note that although the network licence is authorising the use of the user terminal to satellite links, the proposed requirement to cooperate so that different systems can coexist applies to the **whole system** - comprising the satellites, earth stations and user terminals. This is because (as discussed in section 3) the service provided to end users in the UK can be negatively affected by harmful interference arising on a number of different links in the system, including the uplinks and downlinks to/from gateway earth stations.
- 5.10 Satellite network coordination as required under the ITU Radio Regulations is the most important element of the cooperation needed, although it may not always be sufficient to ensure that services can be provided in the UK. In particular:
- Coordination between networks filed through the same country is not dealt with under the Radio Regulations, which only deals with coordination between different countries.
 - Even where a ITU coordination agreement exists, this may not deal with the specific locations of gateway earth station sites within the UK, even if the general conditions for coexistence between gateways is. Therefore, given that the NGSO gateways for

different operators may require significant physical separation, further cooperation between operators would be necessary on the location of UK gateway sites.

Notification of NGSO licensees under condition 1

- 5.11 Ofcom will identify which NGSO licensees are operating on common frequencies and notify this list to the licensee. In determining this list we will review all licensees holding NGSO network licences and NGSO gateway earth station licences and establish whether the frequencies used²² overlap with any of the other NGSO licensees. We will initially do this following the conclusion of this consultation and will thereafter update the list, and notify licensees if appropriate, following the issuing of new NGSO licences.
- 5.12 Under this condition we would expect to notify that the “NGSO licensees” are:
- Network Access Associates Ltd (UK) (trades under the name “OneWeb”)
 - Kepler Communications Inc.
 - STARLINK INTERNET SERVICES LIMITED (Starlink satellite broadband services are provided by SpaceX)

Cooperation under condition 2

- 5.13 As coordination discussions can take many months, we would wish to see evidence that they are progressing in a timely fashion and that both parties are participating constructively. We may ask licensees for evidence on the progress of these discussions and may facilitate discussions between operators in order to ensure sufficient and timely progress is made.
- 5.14 In addition, in considering whether licensees are cooperating sufficiently and making satisfactory progress under this condition, we may take account of:
- The practical feasibility of licensees cooperating to ensure coexistence, if for example, the design of the systems operated by other NGSO licensees is not yet sufficiently completed or stable.
 - Whether services are intended to be provided by other NGSO licensees and when they are expected to be provided. If no services are intended to be offered by other NGSO licensees then coexistence between systems becomes irrelevant.
- 5.15 Failure to cooperate under condition 2, “such that network services can be provided to end users” will increase the likelihood that user services will be disrupted such that the conditions 3-5 (discussed below) are triggered.

²² Note that the network licence currently authorises the use of multiple bands, not all of which may be planned to be used by the licensee. In this case Ofcom may seek additional information from the network licensees in order to establish which ones are overlapping in frequencies actually used or planned to use.

Proposed requirement to comply with notice if services are degraded

Draft new network licence conditions 3 – 5:

Requirement to comply with notice if services are degraded

3. In the event that –

- one (or more than one) of the NGSO Licensees suffers a material and recurring degradation of services to its users at a specific region or location in the United Kingdom; and
- the degradation of services is resulting from radio transmissions from the earth stations, the satellite or any other part of the satellite system operated by another of the NGSO Licensees, including the Licensee;

Ofcom may instruct the Licensee to cease or change the use of particular equipment or particular radio frequencies which are authorised under a wireless telegraphy licence (including but not limited to radio frequencies authorised under this Licence) and are used by any part of the satellite system.

4. Any such cessation or change must be for the purposes of ensuring that such interference is avoided and the degradation of services to users at the particular regions or locations is resolved.
5. Following receipt of such notice, for such period of time as may be specified in the notice, the Licensee may only operate in accordance with the terms and conditions of the notice.

5.16 The aim of draft new conditions 3-5 is to enable us to require operators to take action, including requesting a change of frequency if needed, in cases of interference between NGSO systems which materially degrades the provision of services to users in specific location(s) in the UK.

5.17 In considering whether to take action under condition 3 we propose that we would consider:

- Whether there is a material and recurring degradation of services to users in the UK. What constitutes material degradation will depend on the nature of the service being offered, for example, what is 'material' would vary between a high reliability link to a business customer and a consumer broadband service. Evidence we may look at could include degradation to availability, throughput (both uploading and downloading data from the user) and signal to noise ratio at the user terminal. We recognise that any impact of NGSO-to-NGSO interference is likely to be recurrent, rather than continuous, in nature due to satellites of both systems moving in non-geostationary orbits.
- Whether this degradation is being caused by transmissions from a NGSO operator (rather than for example some fault or limitation arising solely within one particular NGSO system). In establishing this we are likely to consider the timing of degradations

to user services and the correlation of that timing with (predicted) in-line events between two different NGSO systems (based on ephemeris data).

- 5.18 Consistent with our regulatory principles,²³ we would look to see if operators have attempted to resolve issues between themselves and whether it is possible for them to do so, before resorting to regulatory action, and aim to ensure that any action we do take is evidence-based and proportionate.
- 5.19 The specific action we will require will depend on the facts of the situation, but may include changing the frequencies used by earth stations at specific location(s), changing the power levels used by a particular earth station, introducing an angular separation between satellite systems or – in the most extreme cases – switching off equipment. Factors we will take account of would include statutory duties, including ensuring the optimal use of spectrum, and the UK’s responsibilities under the ITU Radio Regulations including, where appropriate, the status of the filings supporting those systems.
- 5.20 If we consider that it is appropriate and proportionate to take action, then we will send a notification to the licensee telling them what they should do to rectify the degradation of services to consumers, and when they should do it.

ITU obligations

- 5.21 As noted in section 2 it is the regulation of radio frequencies within the UK, under the Wireless Telegraphy Act licensing regime, which is the focus of the document and the proposals in it. The licensees holding Wireless Telegraphy Act licences, including the network licence discussed in this section, may separately have obligations that flow from the ITU Radio Regulations. We are proposing to add a new note, for avoidance of doubt, that the conditions in the licence do not affect these obligations.

Draft note to be added into notes section of network licence

This Licence does not affect any obligations that the licensee may have under the ITU Radio Regulations.

Implications for appropriate entity to hold network licence

- 5.22 We consider that the network licence should be held by an appropriate entity that is able to comply with the conditions in the licence, in particular having control over the whole of the satellite system, including satellite(s), user terminals and gateway earth stations, and the ability to cooperate with other systems so that they are able to coexist.
- 5.23 This would typically be the satellite operator responsible for the entire NGSO satellite system. We understand that a teleport (earth station) operator or a local service provider

²³ See Ofcom’s Regulatory Principles <https://www.ofcom.org.uk/about-ofcom/policies-and-guidelines>

is unlikely to have the required control over the whole system, nor have the role of agreeing how the NGSO system will coexist with other NGSO satellite systems.

Consultation question

Question 4: Do you have any comments on the proposed updates to existing and new NGSO network licences?

6. Proposed updates to existing and new NGSO gateway licences

- 6.1 We are proposing to update the licence conditions for Satellite (Non-Geostationary Earth Station) licences – referred to as NGSO gateway licences in this document – to include additional terms. As explained in Section 3 and Annex 1 these licences are used to authorise spectrum use by the gateway earth stations that connect satellites to the fixed networks, including the internet.
- 6.2 The new terms would be included as standard terms of the NGSO gateway licence issued to future applicants. We would also amend existing Satellite (Non-Geostationary Earth Station) licences to include the updated terms.

Existing licences that we propose to amend

- 6.3 The existing NGSO gateway licences are held by:
- Arqiva Ltd
 - Goonhilly Earth Station Limited
 - STARLINK INTERNET SERVICES UK LIMITED
- 6.4 More details on these licences can be found in the public Wireless Telegraphy Register on our [Spectrum information portal](#).

Proposed updates to existing and new licences

- 6.5 The rationale for updating these licences is similar to that set out in sections 3 and 4. However, there are some differences in the conditions we are proposing due to differences in the typical holders of these licences compared with network licences.
- 6.6 The new terms that we are proposing will:
- Require the radio frequencies authorised to be used in common with other licensees.
 - Require that the earth station must only be used to communicate with a satellite system which has transmissions authorised by a network licence.
 - Enable us to require operators to take action in cases of interference between NGSO systems which impacts the provision of services to users in particular location(s) in the UK.
 - Require licensees to commence and maintain transmissions within 12 months.

Proposed requirement to use frequencies in common with other licensees

- 6.7 We propose to include the same draft condition 1 in the NGSO gateway licence as we have proposed for the network licences, for the same reasons. However, NGSO gateway licences are typically held by teleport operators (responsible for operating the ground station where one or more gateways are sited). As a consequence, if licensed to a teleport

operator, the licensee may not have control over the wider satellite network and, related to this, does not take responsibility for coordination discussions with other satellite operators. Therefore, we are not proposing to include the equivalent of condition 2 (requirement to cooperate with other licensees) that is included in the earth station network licence.

Draft condition 1 for gateway licence:

Use of frequencies in common

1. The radio frequencies authorised by this Licence must be used in common with other non-GSO satellite systems authorised under wireless telegraphy licences granted by OFCOM. These names of these licensees shall be notified by Ofcom to the Licensee from time to time, and together with the Licensee are described as the “NGSO Licensees”.

Proposed requirement to only operate with a system that is covered by a network licence

Draft condition 2 for gateway licence:

Operate with a system covered by a network licence

2. The radio frequencies authorised by this Licence must only be used to communicate with a satellite system which has transmissions authorised under a Satellite (Earth Station Network) wireless telegraphy licence granted by Ofcom.

6.8 Although we are not proposing to include a condition requiring cooperation with other licensees in the gateway licence, there will still be a need for cooperation (for example between satellite operators) to ensure the gateway can co-exist and operate without causing harmful radio interference to other satellite systems. This role should be undertaken by the entity holding the network licence.

6.9 Therefore we are proposing that the gateway licence includes a condition (draft condition 2) that requires it to only used with a satellite system which has transmissions authorised under a network licence. In other words, so long as there is a network licence which covers the satellite system with which the gateway is communicating, we believe this will be sufficient to ensure there is appropriate cooperation.

Proposed requirement to comply with notice if services are degraded

Draft conditions 3 – 5 of gateway licence: Comply with notice if services are degraded

3. In the event that:

- one (or more than one) of the NGSO Licensees suffers a material and recurring degradation of services to its users at a specific region or location in the United Kingdom; and
- the degradation of services is resulting from radio transmissions from the earth stations-operated by the Licensee;

Ofcom may instruct the Licensee to cease or change the use of particular equipment or particular radio frequencies which are authorised under this Licence.

4. Any such cessation or change must be for the purposes of ensuring that such interference is avoided and the degradation of services to users at the particular regions or locations is resolved.
5. Following receipt of such notice, for such period of time as may be specified in the notice, the Licensee may only operate in accordance with the terms and conditions of the notice.

6.10 Proposed conditions 3-5 of the gateway licence are similar to those proposed for the network licence in section 5 and have a similar rationale, to enable us to deal with cases of interference between satellite networks. However condition 3 in the gateway licence is simplified to reflect that the licensee may be a teleport operator and, if so, will not (unlike a satellite operator holding a network licence) have control over other elements of the satellite system beyond the specific link authorised under this licence.

6.11 Otherwise our explanation and proposed guidance on use of these conditions is unchanged from that set out in the previous section.

Requirement to commence and maintain transmissions within 12 months

Draft condition 6 of gateway licence:

Commence and maintain transmissions

6. The Licensee must establish, install and use the Radio Equipment to commence regular wireless telegraphy transmissions in accordance with the provisions of this Licence within twelve months of the date that this Licence is issued, and maintain such transmissions thereafter.

6.12 As discussed in section 3, although we think the risk of real scarcity in gateway sites is low, there is a risk of artificial scarcity if operators apply for licences far in advance of a

potential need and then never actually deploy. To mitigate this risk we are proposing to introduce a requirement for gateway licensees to commence and maintain transmissions within 12 months.

- 6.13 The licensee will have to start transmitting within twelve months of being issued a licence and continue to remain operational after this. If spectrum is not used in this timeframe or is subsequently no longer used, Ofcom may revoke the licence with one month’s notice. Alternatively, we may no longer take this licence into account when assessing the interference that may be caused by a new site when considering a new licence application.

ITU obligations

- 6.14 As for the network licence, we are proposing to add a note for the avoidance of doubt in relation to obligations under the ITU Radio Regulations.

Draft note to be added into Notes section of network licence

This Licence does not affect any obligations that the licensee may have under the ITU Radio Regulations.

Consultation question

Question 5: Do you have any comments on the proposed updates to existing and new NGSO gateway licences?

7. NGSO user terminals operating in Ka band

- 7.1 As explained in section 4, we are proposing to introduce new conditions in network licences to mitigate the risks associated with NGSO systems discussed in sections 3.
- 7.2 This section sets out our proposal to remove some existing exemptions for NGSO systems, such that NGSO Ka band user terminals would need to be operated under a network licence, bringing them in line with NGSO systems with Ku band user terminals.

Implications of current licensing arrangements

- 7.3 NGSO systems using Ka band user terminals have not yet been deployed but, as outlined in Table 1, a number are in development. These systems would create similar types of interference and competition risks as other NGSO user terminals. These risks could even be magnified as user terminals would use the same frequencies as the gateways of NGSO systems being deployed now. As we have explained in section 3, interference into gateway earth stations could affect a large number of user terminals.
- 7.4 For some years, we have exempted the use of satellite terminals in the Ka bands. These are outlined in the Wireless Telegraphy (Exemptions) Regulations²⁴ under the sections High Density Fixed Satellite Services (HDFSS) and Earth Stations on Moving Platforms (ESOMPs).
- 7.5 The Earth Station Network licence includes Ka bands and in practice most satellite operators do hold network licences (even if exemptions exist for some terminals). This is because satellite operators serve multiple markets and other sectors such as maritime or aviation would require a network licence.
- 7.6 However, these exemptions mean some NGSO stakeholders may not apply for a network licence, particularly if the first market they chose to serve was on land. If this occurred, the measures we propose to introduce in network licences would not bite.

Our proposals to amend Wireless Telegraphy (Exemption) Regulations

- 7.7 To ensure that all NGSO systems operate under a network licence, and have the same conditions, we are proposing to amend the Wireless Telegraphy (Exemption) Regulations so that **NGSO land terminals are no longer exempt under HDFSS or ESOMPS and therefore must be operated under a network licence.**
- 7.8 If following this consultation we confirm this policy, we will proceed with making changes to the Wireless Telegraphy (Exemption) Regulations 2021 and relevant Interface Requirements at the next opportunity.

²⁴ [The Wireless Telegraphy \(Exemption\) Regulations 2021 \(legislation.gov.uk\)](https://legislation.gov.uk)

Consultation question

Question 6: Do you agree with our proposal regarding NGSO terminals operating in Ka band?

A1. Additional background information on satellite broadband systems and spectrum use

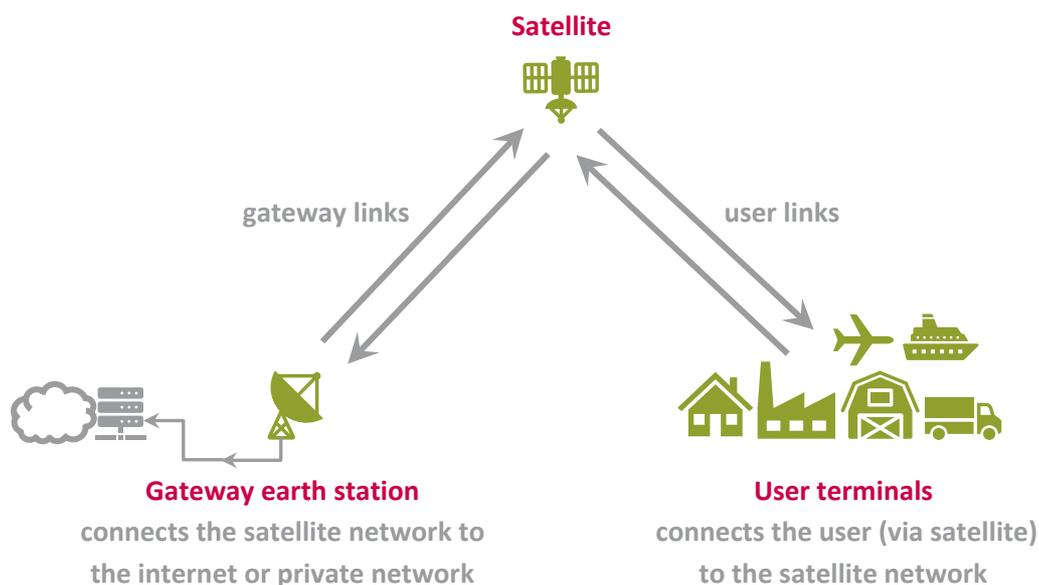
A1.1 In this annex we provide background information about satellite broadband systems and how they use spectrum, including how multiple geostationary orbit (GSO) satellite systems coexist in the same band.

Satellite broadband systems and spectrum use

A1.2 A satellite broadband system is made up of three main components:

- One or more gateway earth stations which connect the satellite broadband network to the internet or private network.
 - These are typically large satellite dishes (e.g. greater than 1.5 metres in diameter), often installed at a site with a number of other satellite dishes. Such a site is sometimes referred to as a **teleport**.
 - The gateway connects the satellite network to the internet and/or to private networks and cloud services.
 - The link between the gateway and the satellite is known as a **gateway (or sometimes feeder) link**.
 - A single gateway will usually serve a large number of user terminals.
- One or more **satellites** used to relay traffic between the gateway and user terminals.
- User terminals to provide broadband connectivity to end users, typically comprising of an antenna and user equipment. These include:
 - terminals installed at a residential or business premises;
 - terminals installed on an aircraft or ship in order to provide broadband to passengers;
 - terminals installed at a mobile base station in order to provide backhaul connectivity for that mobile base station.

Example satellite broadband system



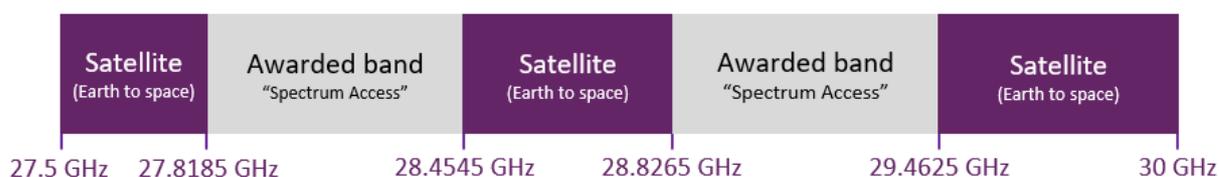
National Wireless Telegraphy Act authorisations

- A1.3 Gateway earth stations and user terminals operating in the UK are authorised under licences issued by Ofcom. Some user terminals are currently exempt from requiring a licence (we discuss this further in section 7). Ofcom also issues radio licences for UK flagged aircraft and ships.
- A1.4 Ofcom does not issue licences for radio transmissions by satellites in space. As discussed in section 2, spectrum use by satellites is coordinated under an international framework coordinated by the ITU.

Authorising gateway earth stations

- A1.5 Licences for gateway earth stations are available in several frequency bands allocated to the fixed-satellite service as defined by the ITU Radio Regulations. These include commonly used frequencies in Ku band (approximately 14 GHz for the uplink and 11 GHz for the downlink) and Ka band (approximately 28 GHz for the uplink and 18 GHz for the downlink).
- A1.6 The diagram below shows parts of spectrum in the UK between 27.5 – 30 GHz that are routinely available for transmitting earth stations, labelled "Satellite" below.

28 GHz band diagram



- A1.7 The remaining portions of spectrum in the two gaps (shown in grey), excluding some guard bands,²⁵ were previously awarded on a technology neutral basis. Further information about the holders of these ‘Spectrum Access’ licences, including the specific frequency bands and geographic areas, can be found on Ofcom’s website.²⁶
- A1.8 Although not limited to satellite use, the spectrum covered by these Spectrum Access licences can be used by transmitting satellite earth stations. Because the licences are tradable (both leasable and transferable), earth station operators can access the spectrum by making commercial agreements with the Spectrum Access licence holders. More information and guidance about spectrum trading can be found in Ofcom’s trading guidance notes (document OfW513).²⁷
- A1.9 Geostationary gateway earth stations are authorised by a “Satellite (Permanent Earth Station)” licence. Non-geostationary gateway earth stations are authorised by a “Satellite (Non-geostationary Earth Station)” licence, referred to in the rest of this document as a “gateway licence”.

Authorising user terminals

- A1.10 User terminals for satellite broadband systems, typically comprising a small antenna and associated equipment, are authorised by a “Satellite (Earth Station Network)” licence, referred to in the remainder of this document as a “network licence”.
- A1.11 This ‘blanket’ licence is intended to authorise any number of fixed or moving user terminals that operate within the satellite network.²⁸ The user terminals can communicate with satellites in geostationary or non-geostationary orbit in certain frequency bands allocated to the fixed-satellite service. These include commonly used frequencies in Ku band and Ka band.
- A1.12 For mobile user terminals operating on ships or aircraft, the frequencies being used to communicate with the satellite are authorised by a combination of an Earth Station Network and the ship radio licence or aircraft radio licence. This is because ships and aircraft are registered (and their ship or aircraft radio licence is issued) in their country of origin. The Earth Station Network allows a satellite operator to connect to ships or aircraft from any country operating in UK territorial waters or UK airspace so long as the relevant frequencies are listed on their licence.
- A1.13 Land mobile user terminals (on trains or road vehicles) are currently exempt from the need to hold a radio spectrum licence in Ka band. We believe that satellite operators tend to hold Earth Station Network licences (which also cover the use of these frequencies for

²⁵ There is a 10 MHz guard band separating the ‘satellite’ and ‘awarded’ bands in the 28 GHz band (i.e. four 10 MHz guard bands in total).

²⁶ https://www.ofcom.org.uk/data/assets/pdf_file/0027/73926/Spectrum-bands-and-licence-areas-for-28-GHz..pdf

²⁷ https://www.ofcom.org.uk/data/assets/pdf_file/0029/88337/Trading-guidance-notes.pdf

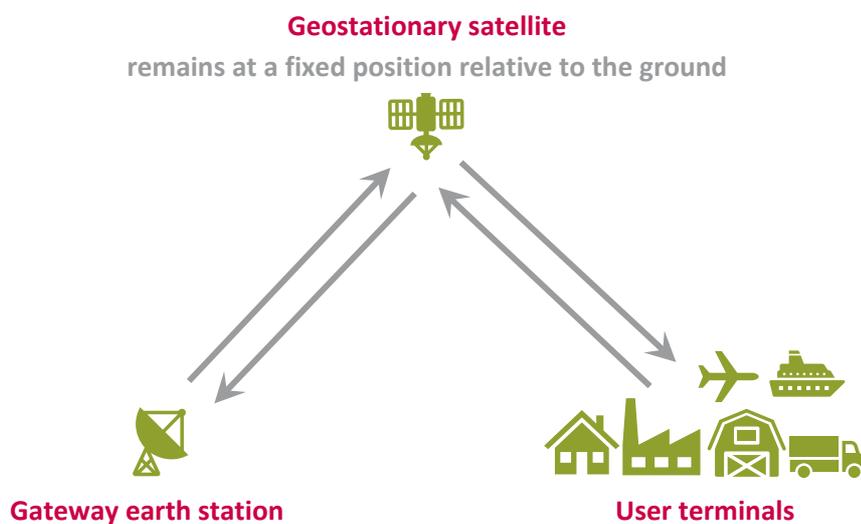
²⁸ Here mobile user terminal denotes a terminal on a moving vehicle on land, at sea or in the air.

these applications) as they typically provide services to a range of different sectors (e.g. air, maritime and rail). There is, however, no formal requirement to do so.

Geostationary Orbit satellite networks

A1.14 Geostationary Orbit (GSO) satellites remain in a stationary position relative to the Earth's surface because they are orbiting at same speed and direction as the Earth is rotating. This means they stay in the same spot in the sky (near the horizon in the UK), and so satellite dishes can be fixed to point at them rather than track them across the sky. The distance signals must travel to the satellite and back again lead to a brief delay called latency.

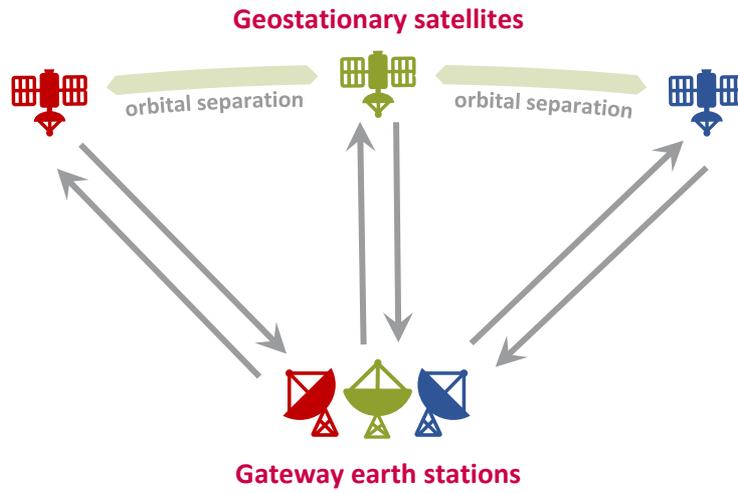
Geostationary satellite network



A1.15 Many GSO satellite services operate on a co-channel basis, i.e. they use the same frequencies in the same location. For some wireless services (like terrestrial mobile services) if operators used the same frequencies in the same location there could be harmful interference between them. However, multiple geostationary operators can operate using the same frequencies and provide services in the same location because:

- Satellites are spaced out in the sky (for example, separated by at least 2 degrees).
- Satellite dishes on the ground are fixed to point quite precisely towards a specific satellite in the sky.
- By pointing at different angles to different satellites, interference between satellite systems can be avoided (see figure below).

How different GSO networks can operate using the same frequencies in the same location



orbital separation between geostationary satellites means that earth stations of different networks can operate from the same location without interference

A2. Additional licence conditions for network licence

New section proposed to be inserted into Satellite (Earth Station Network) licence

Additional conditions for operation with Non-Geostationary Satellites

1. The radio frequencies authorised by this Licence must be used in common with other non-GSO satellite systems authorised under wireless telegraphy licences granted by OFCOM. These names of these licensees shall be notified by Ofcom to the Licensee from time to time, and together with the Licensee are described as the “NGSO Licensees”.
2. The Licensee shall cooperate with all NGSO Licensees such that each satellite system (comprising the satellites, earth stations and user terminals) can co-exist and operate within the United Kingdom without causing harmful radio interference to each other, such that network services can be provided to end users.
3. In the event that –
 - a) one (or more than one) of the NGSO Licensees suffers a material and recurring degradation of services to its users at a specific region or location in the United Kingdom; and
 - b) the degradation of services is resulting from radio transmissions from the earth stations, the satellite or any other part of the satellite system operated by another of the NGSO Licensees, including the Licensee;

Ofcom may instruct the Licensee to cease or change the use of particular equipment or particular radio frequencies which are authorised under a wireless telegraphy licence (including but not limited to radio frequencies authorised under this Licence) and are used by any part of the satellite system.

4. Any such cessation or change must be for the purposes of ensuring that such interference is avoided and the degradation of services to users at the particular regions or locations is resolved.
5. Following receipt of such notice, for such period of time as may be specified in the notice, the Licensee may only operate in accordance with the terms and conditions of the notice.

Additional note to be inserted into Notes section:

This Licence does not affect any obligations that the licensee may have under the ITU Radio Regulations.

A3. Additional licence conditions for NGSO gateway licence

New section proposed to be inserted into Satellite (Non-Geostationary Earth Station) licence

Additional conditions

1. The radio frequencies authorised by this Licence must be used in common with other non-GSO satellite systems authorised under wireless telegraphy licences granted by OFCOM. These names of these licensees shall be notified by Ofcom to the Licensee from time to time, and together with the Licensee are described as the “NGSO Licensees”.
2. The radio frequencies authorised by this Licence must only be used to communicate with a satellite system which has transmissions authorised under a Satellite (Earth Station Network) wireless telegraphy licence granted by Ofcom.
3. In the event that –
 - a) one (or more than one) of the NGSO Licensees suffers a material and recurring degradation of services to its users at a specific region or location in the United Kingdom; and
 - b) the degradation of services is resulting from radio transmissions from the earth stations-operated by the Licensee;

Ofcom may instruct the Licensee to cease or change the use of particular equipment or particular radio frequencies which are authorised under this Licence-

4. Any such cessation or change must be for the purposes of ensuring that such interference is avoided and the degradation of services to users at the particular regions or locations is resolved.
5. Following receipt of such notice, for such period of time as may be specified in the notice, the Licensee may only operate in accordance with the terms and conditions of the notice.
6. The Licensee must establish, install and use the Radio Equipment to commence regular wireless telegraphy transmissions in accordance with the provisions of this Licence within twelve months of the date that this Licence is issued, and maintain such transmissions thereafter.

Additional note to be inserted into Notes section

This Licence does not affect any obligations that the licensee may have under the ITU Radio Regulations.

A4. Responding to this consultation

How to respond

- A4.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 20 September 2021.
- A4.2 You can download a response form from <https://www.ofcom.org.uk/consultations-and-statements/category-2/non-geostationary-satellite-systems>. You can return this by email or post to the address provided in the response form.
- A4.3 If your response is a large file, or has supporting charts, tables or other data, please email it to NGSO.Licensing.Consultation@ofcom.org.uk, as an attachment in Microsoft Word format, together with the [cover sheet](#). This email address is for this consultation only, and will not be valid after 5pm on 20 September 2021.
- A4.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:
- Spectrum Group
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- A4.5 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:
- Send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files. Or
 - Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.
- A4.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)
- A4.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.
- A4.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.
- A4.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 7. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

- A4.10 If you want to discuss the issues and questions raised in this consultation, please email NGSO.Licensing.Consultation@ofcom.org.uk.

Confidentiality

- A4.11 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on [the Ofcom website](#) as soon as we receive them.
- A4.12 If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.
- A4.13 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A4.14 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our [Terms of Use](#).

Next steps

- A4.15 Following this consultation period, Ofcom plans to publish a statement in Q4 2021.
- A4.16 If you wish, you can [register to receive mail updates](#) alerting you to new Ofcom publications.

Ofcom's consultation processes

- A4.17 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 5.
- A4.18 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.
- A4.19 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Email: corporationsecretary@ofcom.org.uk

A5. Ofcom's consultation principles

Ofcom has seven principles that it follows for every public written consultation:

Before the consultation

- A5.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

- A5.2 We will be clear about whom we are consulting, why, on what questions and for how long.
- A5.3 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.
- A5.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.
- A5.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.
- A5.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

- A5.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A6. Consultation coversheet

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing

Name/contact details/job title

Whole response

Organisation

Part of the response

If there is no separate annex, which parts? _____

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name

Signed (if hard copy)

A7. Consultation questions

Question 1: Do you have any comments on our assessment of the interference challenges raised by NGSO systems and their potential impact on a) service quality; and b) competition?

Question 2: Do you have any comments on our approach to dealing with the interference challenges raised by NGSO systems?

Question 3: Do you have any comments on the proposed updates to our process for NGSO gateway and network licences?

Question 4: Do you have any comments on the proposed updates to existing and new NGSO network licences?

Question 5: Do you have any comments on the proposed updates to existing and new NGSO gateway licences?

Question 6: Do you agree with our proposal regarding NGSO terminals operating in Ka band?