Your response

Question	Your response
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?	Confidential? – N Amazon applauds Ofcom on the initiative to update its NGSO licensing framework, and welcomes the opportunity to respond to this consultation. Amazon plans to launch and operate Project Kuiper, a constellation of 3,236 non-geostationary (NGSO) satellites in low earth orbit (LEO) that will provide high-speed, low-latency broadband services to households, businesses, and other customers, connecting unconnected and under-connected communities around the globe. Interest in next-generation NGSO fixed-satellite service (FSS) systems has increased substantially in recent years. NGSO FSS systems can achieve higher throughput and lower latency than their predecessors, finally enabling widescale deployment of fiber-like satellite connectivity to hard-to-reach places. However, coordination between these next generation NGSO FSS systems can be challenging due to their technical complexity, the variable nature of interference, and the limited availability of spectrum. We agree with much of Ofcom's analysis regarding the challenges associated with licensing such networks. Good faith coordination is the keystone of coexistence among licensees. Harmful interference between networks filed at the International Telecommunication Union (ITU) by different countries can be dealt with through the ITU framework. However, we also agree that relying solely on the ITU framework may not be sufficient to effectively and swiftly deal with service quality concerns for services provided by NGSO FSS operators in the UK. These challenges can be mitigated by establishing a sharing framework based on NGSO FSS performance characteristics, which we describe under Question 2. Although Ofcom does not specify the frequencies, we recommend Ofcom apply the licensing updates to NGSO FSS systems operating in Ku-, Ka-, and V-bands. We also generally agree with Ofcom's analysis regarding the challenges associated with gateway location, but note that the need for separation between the gateways of two systems decreases as information sharing increases. Co-located NGSO FSS gateways may coexist with minimal impact if the operators share sufficient information and if the system designs complement each other (for example, one or both systems may have the capability to connect a given satellite to one of several gateways and avoid in-line events). In addition, the nature of typical gateway antennas (i.e. high gain, high off-axis discrimination) reduces the likelihood and duration of in-line interference events. The

	issue of scarcity of gateway sites impacting competition may not therefore be significant. Information exchange between operators on gateway deployment will ensure optimal siting.
Question 2: Do you have any comments on our approach to dealing with the interference challenges raised by NGSO systems?	Confidential? – N Amazon welcomes efforts to provide regulatory certainty to service providers, promote competition, and improve the quality of service to all UK customers of NGSO FSS systems. We also agree that Ofcom can play a beneficial role in improving cooperation between operators (e.g., in relation to providing information on the siting of gateway earth stations) and acting in cases where degradation of service has occurred in the UK. We support an explicit license condition requiring NGSO FSS licensees to cooperate so that they can coexist; however, this condition should not require completion of coordination at the application stage. To achieve this aim, Amazon proposes that: a) Ofcom require that NGSO FSS system operators share sufficient information to anticipate and avoid harmful interference between systems, and b) Ofcom adopt a common permissible interference baseline for all NGSO FSS systems in the Ku-, Ka- and V-bands. Adopting a common baseline would allow operational systems to know to what degree they can expect to be protected, and allow future systems to make design decisions in order to coexist with existing systems. It would also promote competition within the industry as existing licensees would be required to accommodate newcomers. Ofcom proposes looking at whether a system experiences degradation, specifically to link availability and throughput, when investigating cases of interference between NGSO FSS systems (see paragraph 5.17 of the Consultation). Amazon agrees with these metrics, and proposes that Ofcom use link availability and average throughput, which are typical performance metrics for modern NGSO FSS systems. In proposing this performance metric, we refer to the precedent established at the 2019 World Radiocommunication Conference (WRC-19) for NGSO / GSO sharing in the Q/V band.[1] This threshold is a single-entry metric applied to each and every NGSO FSS system and defines a permissible level of interference as a **3% increase in unavailability and a 3% allowance in the reduction of time-averaged weighted degraded throughput** ("baseline sharing threshold"). This threshold can also be applied to NGSO FSS sharing (see attached Technical Annex for further detail). NGSO FSS operators may negotiate a higher level of acceptable interference through coordination, but would otherwise operate to this permissible interference baseline.

[1] See Resolution 770 (WRC-19).

	Amazon also proposes that this baseline sharing threshold be a license condition applied to both new and existing NGSO FSS licenses. Existing and new-entrant NGSO FSS systems operating in the UK would then be required to operate their systems based on the knowledge that their operations to serve the UK are expected to conform to this common baseline in the absence of completion of coordination. Our suggestions for incorporating this baseline sharing threshold are described in detail in our response to Question 4. If the baseline sharing threshold is implemented as a license condition per our suggestions, it would not be necessary for Ofcom to carry out detailed checks at the application stage (when the system design may still be evolving), which would have a chilling effect on coordination. Instead, an operator's acceptance of, and Ofcom's verification against, this performance measure - combined with corrective measures if shown not to be met - should be sufficient to address Ofcom's stated challenges. See our response to Question 4 for further details regarding proposed license conditions and interference resolution.
Question 3: Do you have any comments on the proposed updates to our process for NGSO gateway and network licences?	Confidential? – N Ofcom proposes a new process whereby a series of checks will be conducted by Ofcom to determine the ability of the applicant to coexist with others, promote competition, and ultimately create choice for customers. Some elements of the proposed checks are straightforward, such as verifying the status of ITU coordination. However, some elements are not clearly defined in terms of technical data to be submitted upon application and what criteria Ofcom will apply in its evaluation, creating risks of unequal treatment. Ofcom's proposals introduce subjectivity about criteria for assessing interference potential (for example terms such as "unrealistic levels of interference" and "reasonable mitigations") and would increase uncertainty for operators. At the application stage, Ofcom's proposals would require applicants to submit - in the absence of completed coordination - extensive technical material analogous to that provided during coordination, posing an unreasonable burden on the operator. These proposals increase the risks both of an applicant making its own interpretations about the coexistence data it submits and of Ofcom subsequently making inconsistent judgements should interference occur. Where the standard of compliance is not clear, certainty of protection for operators is also not clear. As stated in our response to Question 2, a more efficient means of ensuring coexistence at the application stage will be a license condition that, in the absence of coordination, operators commit to meeting the above-mentioned baseline sharing threshold for operations in the UK.

	Under Amazon's proposal, NGSO FSS systems would not be required to submit extensive technical analysis in advance of licensing, and clear criteria could be used to resolve cases of interference for existing operators and new entrants. This simplified means of ensuring coexistence, for both gateway and network licenses, would clearly define what cooperation means in the UK, eliminating uncertainty and ambiguity for Ofcom as well as operators. Regarding Gateway licensing: we refer to earlier comments regarding co-location (see Question 1). Regarding Network licensing: Under Ofcom's proposals, an operator would be obligated to hold a network license in advance of a gateway license in order to demonstrate its control over the whole of the network. Ofcom's proposals could have the unintended consequence of constraining gateway deployment planned by operators in advance of making customer terminals available. Ofcom should therefore adopt flexibility to the order of gateway and network licensing. Amazon supports Ofcom's proposals to publish details of license applications, enabling stakeholders to comment on them and enhancing transparency. We also support Ofcom's seeking further information to ensure its review can be appropriately carried out.
Question 4: Do you have any comments on the proposed updates to existing and new NGSO network licences?	Confidential? – N We agree with Ofcom that NGSO FSS licenses should contain a condition to cooperate with all other NGSO FSS licensees to co-exist without causing harmful radio interference to each other. Amazon proposes that Ofcom's draft condition 2 for a network license be expanded to specify that NGSO FSS system operators must share sufficient operational information with other NGSO FSS system operators to anticipate potential harmful interference events, including information about satellite trajectories and intended use of frequencies. NGSO FSS system operators should indicate which of their satellites are actively serving which earth stations in which frequency band, thereby facilitating coordination to prevent interference between NGSO FSS systems and enabling more efficient use of spectrum. We also agree that in cases of interference, operators should first try to resolve issues between themselves before resorting to regulatory action, as indicated in 5.18 of the consultation. Further, we propose that Ofcom should modify the licensing framework and existing network licenses to require all NGSO FSS network licenses in the Ku-, Ka- and V-bands within the UK to comply with the common baseline thresholds as discussed in Questions 1-3. Specifically, we propose to replace Ofcom's draft network license conditions 3 to 5 with the following interference procedure if services are degraded:

	"3. In the event that • One (or more than one) of the NGSO FSS Licensees suffers a material and recurring degradation of services ("interference") 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 FSS Licensees or resulting from interfered-with system's own operations; The following procedure is to be followed: • The interfered-with system shall identify suspected causes of interference and make reasonable efforts to determine the source of the problem. • If the source of the interference is identified as another NGSO FSS system, the interfered-with system operator shall contact the suspected interfering system operator to seek assistance in resolving the interference. The interfered-with system shall co-operate and provide all useful information in order to help identify the source of the interference and the nature of the material and recurring degradation of service and remediate the interference. • If the source of the interference cannot be identified, the interfered-with system shall seek the assistance of Ofcom, providing evidence of the interference and identifying the steps that have been taken to identify the source of the interference and the nature of the material and recurring degradation of service. If necessary to determine the source and characteristics of, and to establish the responsibility for, the interference, Ofcom may seek the cooperation of the other NGSO FSS operators to furnish ephemeral data necessary to allow determination of the positions of the space stations when not otherwise known. • Once a suspected interfering system has been identified either by the interfered-with system or with Ofcom's assistance, the suspected interfering system shall take reasonable measures to confirm that its operations are the source of the interference problem. Where the operations of the suspected interfering system are shown to be the source of interference above permissible levels established by the baseline sharing threshold, the interfering system shall reduce interference to permissible levels as defined by the baseline NGSO FSS sharing threshold. 4. If the process above does not resolve the interference, the interfered-with system operator and suspected interfering system operator may seek the assistance of Ofcom to evaluate whether the interference is within permissible levels, as defined by the baseline NGSO FSS sharing threshold. If Ofcom determines that the operations of the suspected interfering system are in excess of the baseline sharing threshold, Ofcom may require the operator of the interfering system to comply with the baseline sharing threshold established for permissible interference."

Question 5: Do you have any comments on the proposed updates to existing and new NGSO gateway licences?	Confidential? – N Regarding the application of conditions 3-5, and their relation to condition 2, Amazon proposes the same principles relating to a common baseline. Furthermore, there should be no restriction on the ability for NGSO FSS gateways to be co-located. Amazon agrees with the proposals that satellite operators would cooperate to resolve interference cases where gateways are managed by third parties.
Question 6: Do you agree with our proposal regarding NGSO terminals operating in Ka band?	Confidential? – N Amazon agrees with the proposal to remove the current exemption under HDFSS or ESOMP regulation for NGSO land terminals operating in the Ka-band. All NGSO FSS terminals should be subject to the same regulatory framework for purposes of clarity and efficient use of the spectrum to facilitate coexistence, which is the ultimate goal suggested by Ofcom.

Please complete this form in full and return to NGSO.Licensing.Consultation@ofcom.org.uk.

NOTE: Please see attached Technical Annex

Technical Annex

Amazon proposes to establish a baseline threshold to define permissible interference for all UK NGSO FSS licensees. Its proposed use is described in Amazon's response to Questions 2 and 4 of the consultation. Further information follows.

The common baseline Amazon proposes is a combination of an unavailability metric and a time averaged degraded throughput metric, with an allowable maximum permissible level of interference of 3% single entry per-system increase in unavailability and a metric of 3% degraded throughput. These thresholds are applied to a specific Earth station or space station. The calculation techniques associated with the proposed baseline are derived from supporting ITU-R Recommendations and, in particular, sharing techniques from Resolution 770 (WRC-19), which describes sharing procedures between GSO networks and NGSO FSS systems in the Q/V bands. The metric of unavailability allows the protection of satellite links from high bursts of interference and is a short-term protection threshold which is measured by a consideration of at most 3% time allowance for the C/N value associated with the short-term performance objective of the victim satellite link. The metric of degraded throughput is measured as an allowance of at most a 3% reduction in time-weighted average spectral efficiency calculated on an annual basis of the victim satellite link. It is important to have a combination of both metrics as these two parameters assure the protection of the operation of modern NGSO FSS systems.

While the concept described in Resolution 770 (WRC-19) represents the current regulatory procedures for evaluating interference between NGSO satellite networks and victim GSO systems, the metrics used in Resolution 770, namely unavailability and throughput, can similarly be applied to the evaluation of interference levels between two NGSO FSS satellite networks. In particular, the development of the concepts in Resolution 770 (WRC-19) indicated that these two metrics are appropriate for the evaluation of interference into next generation satellite systems.

Unavailability is calculated by a comparison of the convolution results of propagation fade and interference to the short-term performance objectives associated with the lowest C/N of the victim performance requirements. The degraded throughput calculation is focused on satellite systems utilizing adaptive coding and modulation by calculating the throughput degradation as a function of C/N, which varies depending on the propagation and interference impacts on the satellite link over the long term. Both of these metrics apply similarly to interference between NGSO FSS systems as they do to interference conditions between NGSO FSS systems and GSO networks.

Ofcom has correctly recognized in its consultation that the metrics of unavailability and throughput degradation are appropriate for consideration of sharing between NGSO FSS systems. As the combination of these two metrics were deemed appropriate for the consideration of interference *from* a NGSO FSS system, it is proposed to consider these same interference thresholds for the evaluation of interference *between* NGSO FSS systems. NGSO FSS systems are already designing their operations to comply with these metrics. Thus, it is proposed to consider the same single-entry metric of a 3% increase in unavailability and a 3% allowance in the reduction of the time-averaged weighted degraded throughput as has been considered in other instances of evaluating permissible interference from NGSO FSS systems.