An Coimisiún um
Rialáil Cumarsáide
Commission for
Communications Regulation

Application for a satellite earth station licence to support Amazon's Kuiper satellite system

Information Notice

Reference: ComReg 25/36R

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Annex

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1   Background Information

1.1   Non-geostationary orbit ("NGSO") satellite systems deliver broadband services from space using a constellation of satellites, usually in a low or medium earth orbit. The user terminals operate on licence-exempt basis in-line with ComReg Document 20/47, as amended.[1]

1.2   On 29 May 2025, ComReg received an application (the "Application") from Amazon Kuiper Services Europe SARL ("Amazon") for a wireless telegraphy satellite earth station ("SES") licence to operate within the 18 GHz[2] and 28 GHz[3] frequency bands in Elfordstown, Midleton, Co. Cork.

1.3   The granting of an SES licence would authorise Amazon to operate an SES in Ireland to connect to its Kuiper NGSO system to provide satellite broadband services directly to customers in Ireland, and to provide backhaul solutions for wireless carriers, extending the Long-Term Evolution ("LTE") and Fifth Generation ("5G") service in regions where terrestrial backhaul solutions are either not feasible or expensive to implement. The proposed frequencies and technical details of the application are set out in tables 2 – 4 of annex 1 of this document.

1.4   As set out in ComReg Documents 23/96[4] and 24/48[5] there is a revised process for considering radio licence applications for NGSO SES which connect NGSO systems to the internet or to a private network. The purpose of the process is to assist in ensuring the co-existence of networks and services which have a co-primary allocation in certain frequency ranges.

1.5   The 18 GHz and 28 GHz frequency bands are also available for fixed radio link licensing within the 17.7-19.7 GHz and 27.9405-28.4445 GHz paired with 28.9485-29.4525 GHz ranges. The 18 GHz band is allocated for satellite services in the Space-to-earth direction (receive), while the 28 GHz band is allocated for satellite services in the Earth-to-space direction (transmit).

1.6   There are no fixed radio links using the 18 GHz band nearby the proposed site of the SES. The nearest fixed radio links operating in 18 GHz band are approximately

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[1] https://www.comreg.ie/media/2023/10/ComReg-2047R5.pdf

[2] 17.7-19.7 GHz (Space-to-earth)

[3] 27.5-29.5 GHz (Earth-to-space)

[4] See Annex 2 of ComReg Document 23/96 – Review of the Satellite Earth Station Licensing Regime: Response to Consultation and Decision – published 4 October 2023. https://www.comreg.ie/media/2023/10/ComReg-2396.pdf
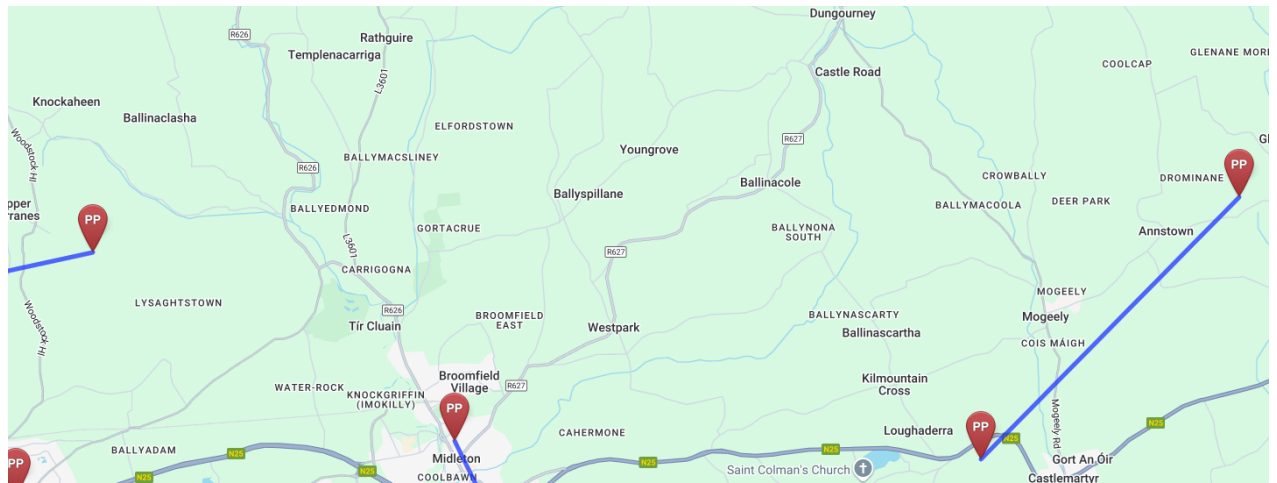
[5] ComReg Document 24/48 – Satellite Earth Station Licensing Guidelines – published 17 June 2024. https://www.comreg.ie/media/2024/06/ComReg-2448.pdf

4 km away in the south and south-west direction.

Figure 1: Licensed fixed radio links in the 18 GHz band near the Elfordstown area

1.7   There are no fixed radio links operating in the 28 GHz band in close proximity to the proposed site of the SES. The nearest fixed radio links operating in 28 GHz band are approximately 7.5 km away in the south-west direction.

Figure 2: Licensed fixed radio links in the 28 GHz band within the Elfordstown area
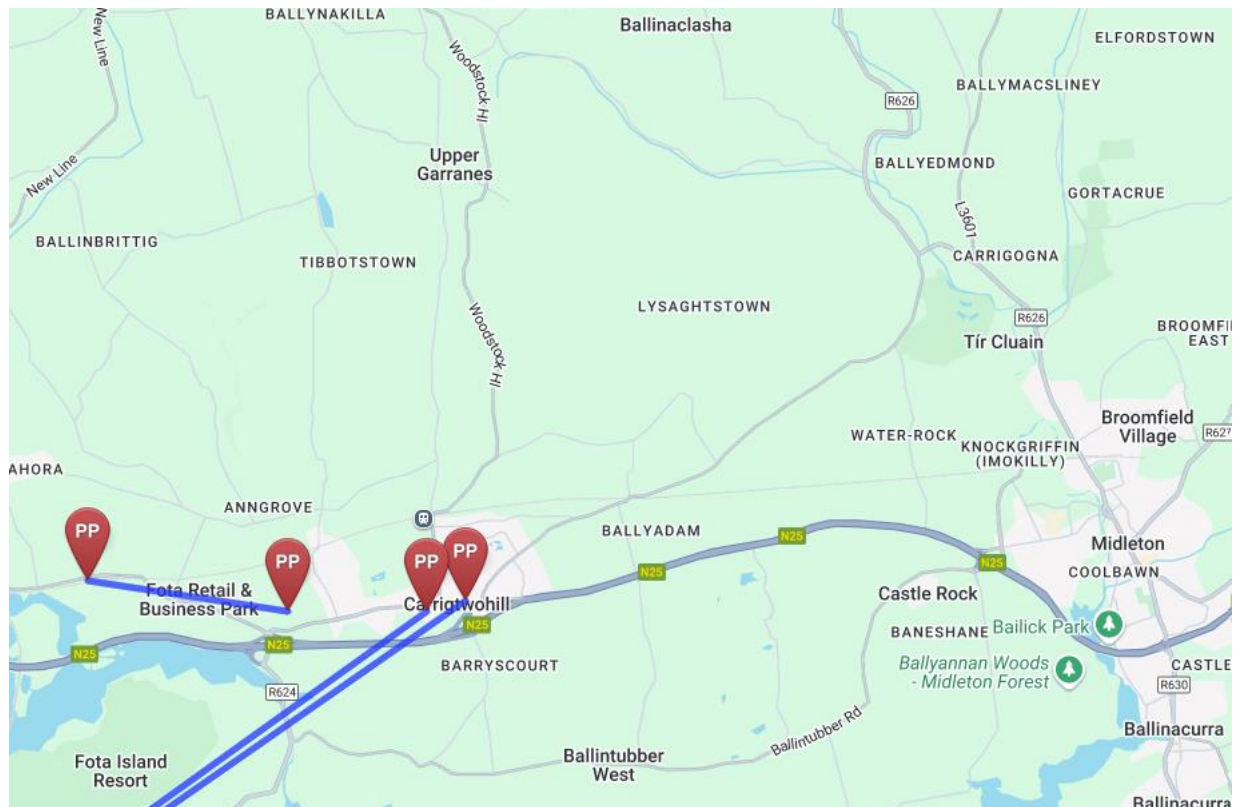
1.8 When considering licence applications for SES operating with an NGSO network, ComReg considers coexistence with existing users licensed in co and adjacent frequencies.

1.9 The purpose of this Information Notice is to make interested parties aware in the event they wish to make a submission regarding the coexistence of the proposed SES with other services in the 18 GHz and 28 GHz bands, particularly regarding coexistence with other licensed networks and services.

Chapter 2

2 Description of system and coexistence

2.1   Amazon states that it is requesting authorisation to enhance the connectivity capabilities and capacity for the future users of its satellite services by installing an NGSO SES in Elfordstown.

2.2   Amazon's Kuiper SES would operate in the frequency bands shown in the table below.

Table 1: Proposed operating frequency bands

Frequency Band (GHz)	Use	Satellite Antenna Type	Link Polarization
17.7-18.6 18.8-20.2	Gateway Links (S-e)[6]	Parabolic	RHCP[7]/LHCP[8]
27.5-30.0	Gateway Links (E-s)	Parabolic	RHCP/LHCP

2.3   Amazon states that the Kuiper satellite system (the "satellite system") will be comprised of the satellite constellation, customer terminals (for end users), gateway earth stations, and dedicated telemetry, tracking and command ("TT&C") earth stations. The satellite system will also provide backhaul solutions for mobile network operators, helping extend wireless services to more unserved and underserved customers, and deliver high-throughput mobility applications for aircraft, maritime vessels, and land vehicles.

2.4   Amazon plans to provide the following electronic communications services in Ireland:

(a)   Retail internet access and connectivity services to consumers, enterprises, government, and public entities, via satellite;

(b)   Wholesale internet access services and connectivity to local/regional partners who will on-sell services to enterprise users and public entities in-country, via satellite; and

(c)   Backhaul services to telecommunications carriers, via satellite.

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[6] "S-e" means space-to-earth and "E-s" means earth-to-space, the directions of transmission.
[7] Right Hand Circular Polarization (RHCP)
[8] Left Hand Circular Polarization (LHCP)

2.5   The full parameters of the proposed SES are set out in tables 2-4 in annex 1.

2.1   Coexistence

2.6   When assessing applications for new licences, ComReg must consider whether the proposed deployments are capable of coexisting with existing users (in those bands where they have a co-primary allocation with another service), such that they are capable of providing services to their users without experiencing harmful interference.

2.7   In that regard, in its application Amazon states that it ran detailed RF interference simulations between the two systems and that the analysis:

(a)   shows the extreme unlikelihood of interference between co-located sites of the two operators at known locations in Ireland; and

(b)   is relative to co-located gateway sites and is thus more conservative than the actual siting of Kuiper and Starlink gateways in Ireland, which are some 50 km apart.

2.8   Amazon also provide the following analysis which, in its view, addresses how NGSO systems share spectrum using methodologies adopted by Kuiper and Starlinks' filing administration, the United States FCC. Amazon states that these methodologies are also being studied in the International Telecommunication Union (ITU) Working Parties for adoption globally.

> ### NGSO Systems Can Share Spectrum
>
> *NGSO system interference is dynamic due to the fast-relative motion of the satellites from the perspective of users on the ground. NGSO systems leveraging millimeter wave (mmW) frequency bands like Ka-band have directional beams with narrow beam widths that point from terminals on the ground and track a satellite as it passes. Interference can theoretically occur when two satellite paths from different NGSO systems appear in-line with one another from the perspective of users on the ground. These events ("in- line events") occur infrequently.*
>
> *To demonstrate the infrequent nature of in-line events, Kuiper simulated the orbits of both the Kuiper System and the Starlink System measuring the topocentric angle from the perspective of a fixed earth station on the. The resulting statistical curves are shown in Figure 1. Assuming the Starlink gateway is steering its beam to point at Starlink satellites, the likelihood that a Kuiper System satellite will be inside the Starlink gateway 3 dB beam*

is 0.00524%.[9] Similarly, the likelihood that a Starlink satellites will be inside a Kuiper gateway 3dB beam is 0.00151%. These values show the extreme unlikelihood of in-line events occurring.

Figure 1: Angle Between Kuiper Satellites and SpaceX Satellites Cumulative Density Function
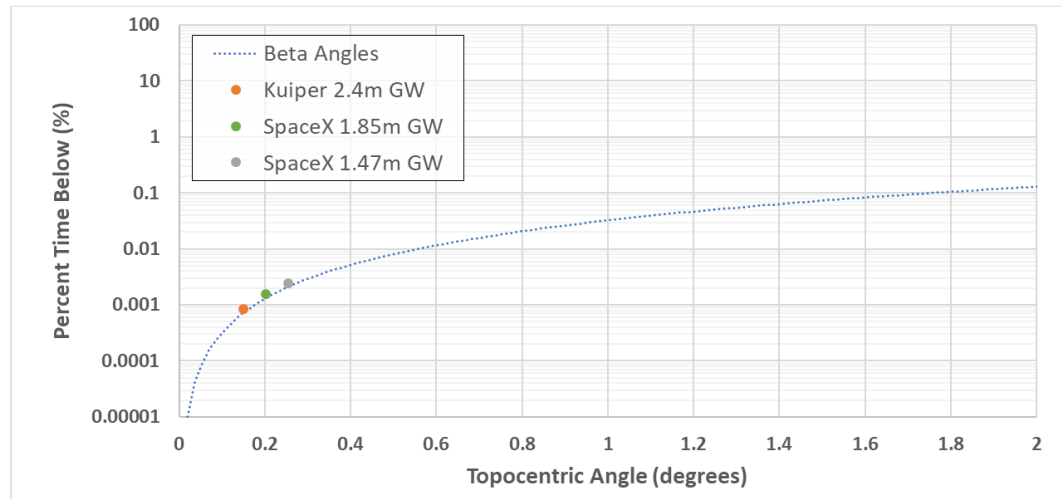
NGSO Spectrum Sharing Metrics and Methodologies

The FCC has adopted a model to determine acceptable levels of interference between NGSO systems. This model is also under consideration in the ITU working parties to come to a consensus regarding its use more globally.

FCC released a Notice of Proposed Rule Making (NPRM) on the topic of spectrum sharing between NGSO systems in different processing rounds.[10] NGSO systems in the same processing round are given equal priority. This NPRM focused on NGSO systems that are authorized in a later processing round and how to ensure earlier processing round systems would be protected from harmful interference. Interested parties provided the FCC with their recommendations for the spectrum sharing rules. This resulted in a Report and Order by the FCC that refined the rules for NGSO FSS spectrum sharing under FCC Rule 25. The FCC requires a compatibility analysis to assess the interference caused by a later processing round system into an earlier processing round system. To determine what level of interference is acceptable in these compatibility analyses, the FCC adopted a 3% time-weighted average throughput degradation as a long-term

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[9] This value assumes the Starlink gateway is comprised of 1.47m diameter antennas. Starlink also uses 1.85m diameter antenna which would result in a smaller 0.00238% value.

[10] The FCC implements a "processing round" framework for NGSO systems which groups applicant systems together into priority groups based on filing dates.

protection criterion and a 0.4% absolute increase in link unavailability as a short-term criterion at a C/N threshold of 0 dB as the short-term interference metric.

Time-weighted average throughput degradation and absolute increase in link unavailability metrics are computed using simulations of the RF environment. First, the interference simulations compute statistics on each systems Carrier-to-Noise ("C/N") ratio in a non-interfered scenario while still considering atmospheric losses using ITU Recommendations ITU-R P.618 and ITU-R P.676. Second, the simulations compute each systems Carrier-to-Noise-plus-Interference ("C/[N+I]") ratio to determine the impact of the potential interference from the Kuiper System while still considering atmospheric losses. The C/N and C/[N+I] statistics are converted into spectral efficiency using ITU Recommendation ITU-R S.2131-1 and the average throughput degradation is computed. Additionally, the likelihood a system is unavailable (C/N or C/[N+I] < 0 dB) is computed for both the non-interfered and interfered scenarios and compared. This results in the increase in unavailability metric.

Kuiper and Starlink Simulations in Ireland

Kuiper has provided technical showings to the FCC in the United States and to Ofcom in the United Kingdom demonstrating the ability for the Kuiper System to coexist with other authorized NGSO systems using the methodology previously described. Both countries have authorized Kuiper's operation and affirmed its ability to coexist with other licensed operators.

Specifically, for Ireland, Kuiper provides demonstrations to show how the proposed gateway earth station located outside of Cork, Ireland can coexist with other NGSO system earth stations. Although Kuiper determined the closest external NGSO system earth station authorized to operate in Ireland is a Starlink gateway about 50km away, the interference simulations conservatively assume the Starlink gateway is co-located with the proposed Kuiper gateway site.[11]

2.9   *Kuiper used the conservative co-location scenario since it results in the higher interference levels compared to reality and it demonstrates that interference levels will be acceptable even in a future scenario where a Starlink gateway may be located closer (or even co-located) with any Kuiper gateway in Ireland. Table 1 and Table 2 show the resulting long-term and short-term metrics with the impact of a Kuiper gateway on a*

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[11] *The proposed Kuiper GWs in Ireland is located at 51.953358 °N, -8.174598 °E. The closest known authorized Starlink GW is 50 km away near Garrettstown. This distance will provide additional isolation compared to the simulations shown.*

Starlink gateway falling well below the metrics agreed upon as acceptable by the FCC thus causing acceptable levels of interference.

Table 1: Link Unavailability (Likelihood C/N <= 0 dB)

	Uplink	Downlink
Link Unavailability - No Interference (%)	0.00629%	0.00403%
Link Unavailability - Co-located Kuiper GW (%)	0.0218%	0.0285%
Absolute Increase in Link Unavailability (%)	0.0155%	0.0245%
FCC Acceptable Threshold (%)	0.4%	0.4%

Table 2: Average Degraded Throughput

	Uplink	Downlink
Average Throughput - No Interference (bps/Hz)	5.93	4.11
Average Throughput - Co-located Kuiper GW (bps/Hz)	5.89	4.09
Degraded Throughput (%)	0.52%	0.63%
FCC Acceptable Threshold (%)	3%	3%

Figure 2 and Figure 3 show the C/N and C/[N+I] cumulative density functions for the SpaceX gateway link. The blue curve shows the assessment of a Starlink gateway operating without interference but with statistical atmospheric attenuation modeled. The orange curve shows the Starlink C/[N+I] considering the interference from a Kuiper gateway operating in the same location. The short-term interference metric compares the likelihood the Starlink C/N goes below 0 dB with and without interference.

Figure 2: Kuiper Gateway Uplink Interference into Co-located Starlink Gateway
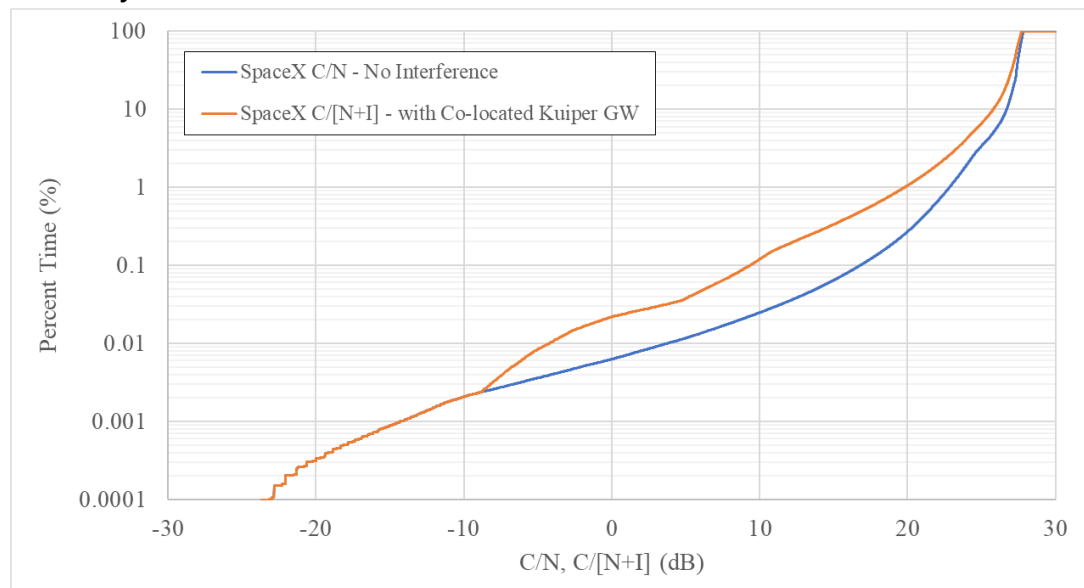
Figure 3: Kuiper Gateway Downlink Interference into Co-located Starlink Gateway
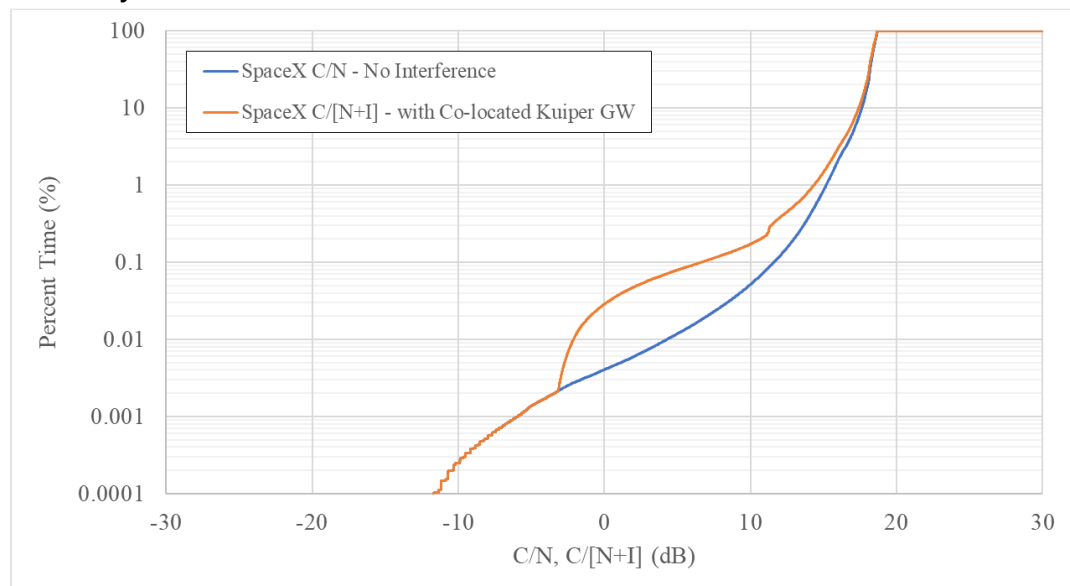
Kuiper Ability to Share with Future NGSO Systems

The Kuiper System has been demonstrated against several other NGSO systems and passes the acceptable interference criteria defined by the FCC. This analysis has been done with the assumption of co-located earth stations to ensure the conclusion is true for future NGSO systems that may obtain earth stations near Kuiper gateway sites.

In the possibility that future NGSO systems cause a higher interference environment, Kuiper has options to perform mitigations to protect itself or others as required. The Kuiper System has been designed to be able to implement satellite avoidance angles where the transmission and receive functions are not used for ground to satellite links during in-line events. Furthermore, the Kuiper System has the ability to reduce power levels on the uplink and downlink as well as implement frequency selectivity to certain geographic areas (e.g., turn off certain sub-bands in regions of harmful interference).

GSO Protection Measures

The Kuiper System has been designed with the capability to protect GSO systems and has multiple mitigation techniques including GSO arc avoidance parameters that have been implemented into planning software. The Kuiper System ITU filings have been evaluated by the ITU for EPFD compliance and received a favourable finding.

ITU-R Resolution 76 (Rev. WRC-23) addresses the requirement for NGSO

systems to protect GSO networks from aggregate interference. This Resolution was modified by WRC-23 to invite the ITU-R to develop two Recommendations with methodologies to calculate aggregate interference into GSO networks from NGSO systems and determine necessary measures to ensure that aggregate epfd limits are met if an exceedance is identified. The consultation meetings to evaluate this aggregate interference will start after the first Recommendation is adopted or by 2027. Amazon and other NGSO operators, in conjunction with operators of GSO networks are actively working to develop these Recommendations within ITU-R WP4A and initiate the consultation meetings in accordance with Resolution 76.

2.2   ComReg's preliminary view

2.10   Taking account of the information and technical parameters provided by Amazon, and having undertaken a initial interference analysis, ComReg is of the preliminary view that the proposed NGSO SES would not cause harmful interference to existing SES and fixed radio links operating in the 28 GHz band. Therefore, ComReg proposes to grant Amazon a licence for its proposed SES at Elfordstown.

2.11   However, ComReg welcomes submissions from interested parties regarding the coexistence of the proposed SES with other services in the 18 GHz and 28 GHz bands. Annex 1 provides the full application details of the proposed SES to enable interested parties to conduct their own assessment of the system and its potential impact on their operations. Respondents should provide reasoning and supporting evidence/information for any views expressed.

3   Next Steps

3.1   Submitting comments

3.1   In accordance with ComReg's Consultation Procedures[12] , the consultation period will run until 17:00 on the 18th of July 2025.

3.2   Responses must be submitted in written form, by email only, to marketframeworkconsult@comreg.ie and clearly marked – Submissions to ComReg Information Notice 25/36.

3.3   Electronic submissions should be submitted in an unprotected format so that they may be readily included in the ComReg submissions document for electronic publication.

3.4   ComReg appreciates that respondents may wish to provide confidential information if their comments are to be meaningful. In order to promote openness and transparency, ComReg will publish all respondents' submissions to this notice, as well as all substantive correspondence on matters relating to this document, subject to the provisions of ComReg's guidelines on the treatment of confidential information (Document 05/24).

3.5   In this regard, respondents should submit views in accordance with the instructions set out below. When submitting a response to this notification that contains confidential information, respondents must choose one of the following options:

   (a)   Submit both a non-confidential version and a confidential version of the response. The confidential version must have all confidential information clearly marked and highlighted in accordance with the instruction set out below. The separate non-confidential version must have actually redacted all items that were marked and highlighted in the confidential version.

3.6   OR

   (b)   Submit only a confidential version and ComReg will perform the required redaction to create a non-confidential version for publication. With this option, respondents must ensure that confidential information has been marked and highlighted in accordance with the instructions set out below. Where confidential information have not been marked as per our

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[12] https://www.comreg.ie/media/2024/01/ComReg2402.pdf

instructions below, then ComReg will not create the non-confidential redacted version and the respondent will have to provide the redacted non-confidential version in accordance with option A above.

3.7   For ComReg to perform the redactions under Option B above, respondents must mark and highlight all confidential information in their submission as follows:

(a)   Confidential information contained within a paragraph must be highlighted with a chosen particular colour,

(b)   Square brackets must be included around the confidential text (one at the start and one at the end of the relevant highlighted confidential information),

(c)   A Scissors symbol (Symbol code: Wingdings 2:38) must be included after the first square bracket.

3.8   For example, "Redtelecom has a market share of [✂ 25%]."

3.2   Next Steps

3.9   Following receipt and consideration of submissions in response to this Information Notice, and other relevant material, ComReg intends to publish an Information Notice setting out its decision regarding the application and any non-confidential submissions received.

Annex 1: Proposed SES operating parameters

Table 2: Proposed SES information

Satellite Network details	Satellite Name	USASAT-NGSO-8A, USASAT-NGSO-8B, USASAT-NGSO-8C
	Type	Non-Geostationary
Earth Station Details	SES Refence Name	ORK501
	SES Type	Fixed Earth Station
	Lat/Long (decimal degrees)	51.953358, -8.174598
	Site Height (AMSL) (m)	93.0
	Antenna Performance Pattern	ITU-R REC-465/Ap8
	Antenna Diameter (m)	2.4
	Antenna Height (above ground level) (m)	1.5
	Tx Antenna Gain (dBi)	53.8
	Tx Antenna beamwidth (degrees)	0.35
	Rx Antenna Gain (dBi)	49
	Rx Antenna Beamwidth (degrees)	0.55
	Antenna Azimuth (degrees)	0-360
	Antenna Elevation (degrees)	20-90
	Receiver System Noise	195

	Temperature (Kelvin)	

Table 3: Proposed transmit parameters

Centre Frequency (GHz)	Bandwidth (MHz)	Polarisation	Power (W)	Polarisation Angle (if appropriate) (degrees)	Designation of Emission (emission code)						Max Antenna Input Peak Power of emission (dBW)
					Necessary bandwidth of emission index	Type of modulation of main carrier	Nature of signal modulating main carrier	Type of information transmitted	Details of signal	Type of multiplexing	
27.925	850	Circular (L+R)	10.00		490M	D	7	W	-	-	12.30
28.1	500	Circular (L+R)	10.00		392M	D	7	W	-	-	10.00
28.425	150	Circular (L+R)	10.00		294M	D	7	W	-	-	4.77
28.55	100	Circular (L+R)	10.00		245M	D	7	W	-	-	3.01
28.85	500	Circular (L+R)	10.00		196M	D	7	W	-	-	10.00
29.175	150	Circular (L+R)	10.00		147M	D	7	W	-	-	4.77
29.375	250	Circular (L+R)	10.00		98M0	D	7	W	-	-	6.99
29.75	500	Circular (L+R)	10.00		49M0	D	7	W	-	-	10.00

The table header row "Transmit Parameters" spans the full width of the table.

Table 4: Proposed receive parameters

Receive Parameters									
				Designation of Emission (emission code)					
Centre Frequency (GHz)	Bandwidth (MHz)	Polarisation	Polarisation Angle (if appropriate) (degrees)	Necessary bandwidth of emission index	Type of modulation of main carrier	Nature of signal modulating main carrier	Type of information transmitted	Details of signal	Type of multiplexing
17.75	100	Circular (L+R)		490M	D	7	W	-	-
18.05	500	Circular (L+R)		392M	D	8	W	-	-
18.45	300	Circular (L+R)		294M	D	9	W	-	-
19.05	500	Circular (L+R)		245M	D	10	W	-	-
19.35	100	Circular (L+R)		196M	D	11	W	-	-
19.50	200	Circular (L+R)		147M	D	12	W	-	-
19.65	100	Circular (L+R)		98M	D	13	W	-	-
19.95	500	Circular (L+R)		490M	D	14	W	-	-