STARLINK

19 March 2025

Supporting Submission for temporary E-band NGSO Gateway Licence

Starlink Internet Services Limited ("Starlink"), a subsidiary of SpaceX, is seeking to enhance connectivity capabilities and capacity in the UK. To that end, Starlink is requesting temporary E-band licenses at the following three non-geostationary (NGSO) gateway sites already licensed for Ka-band:

- Morn Hill (existing Ka-band licence number 1293713)
- Wherstead (existing Ka-band licence number 1293534)
- Woodwalton (existing Ka-band licence number 1293303)

Specifically, as part of its efforts to meet growing demand for high-speed, low latency broadband connectivity, Starlink is now requesting to expand access at the three sites above to include E-band capability. The E-band frequencies that Starlink is requesting are: 71-76 GHz (space-to-Earth) and 81-86 GHz (Earth-to-space). [CONFIDENTIAL ✂]

Granting access to E-band will also promote competition and benefit consumers and businesses in the UK and will do so without raising any coexistence concerns. Access to higher frequencies like E-band for backhaul communications is necessary to stay ahead of capacity constraints and customer waitlists that occur when adding significantly more customers to the network, ensuring that all people in the UK have access to a competitive satellite broadband option. Additional backhaul capability is also critical to ensure that as the network grows, all customers—including consumers, businesses, and government users—continue to enjoy high-speed, low-latency connectivity, which has become essential to keep pace with growing demand for bandwidth-intensive and real-time applications. Fortunately, because transmissions in these bands involve highly directional, narrow beams and small coordination zones around gateway sites, they can readily coexist in close proximity with current and future co-primary deployments with little risk of interference or preclusion of future operations. In addition, granting of these temporary E-band licences will enable Starlink to provide Ofcom with real-world deployment and operational experience to inform Ofcom's ongoing consideration of opening up E-band for satellite use. Further, by using these higher frequencies SpaceX is seeking to make use of underutilized spectrum and relieving congestion in lower bands (or at least not contributing to additional congestion in lower bands).

The following information supports Starlink's request to obtain E-band access for each of the sites:

D1. Coexistence with existing systems:

Explain how your non-geostationary earth station(s) ("Gateways") will be able to coexist with the following:

- ***Existing non-geostationary satellite systems that are licensed in the UK***
- ***Non-geostationary satellite systems for which an application has been made and which has been published for comment on Ofcom's website***
- ***Other specific co-frequency earth stations registered with the ITU***

and

D2. Coexistence with future systems

State what flexibility your Gateways have to coexist with future non-geostationary satellite systems. You should include measures you would be able to put in place if another non-geostationary satellite system were to enter the market in the future, and the expected benefits of such measures. Also state what measures future non-geostationary satellite systems could reasonably be expected to put in place to coexist with your Gateways.

Starlink currently utilizes seven gateway sites in the British Isles, located at Morn Hill, Goonhilly, Chalfont, Fawley, Woodwalton, Wherstead and Isle of Man. These sites currently each make use of Ka-band parabolic antennas and serve customers in the UK and the broader region.

In order to increase capacity to meet growing demand for Starlink's high-speed, low latency broadband service from households, businesses, and government customers in the UK, Starlink is seeking to expand access at the Morn Hill, Woodwalton, Wherstead sites by utilising E-band spectrum.

Proposed E-band model

Starlink's E-band gateway earth stations propose to use high-gain, narrow, directional beams with high minimum elevation angles and low sidelobes, which create small, predictable coordination zones and links that makes them especially well-suited for efficient spectrum sharing. This design facilitates coexistence with incumbent and future fixed links through minimal angular or physical separation.

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Interference and co-existence

Starlink has completed an interference analysis based on accepted international methodologies to demonstrate that E-band use by these satellite gateway earth stations is not predicted to cause harmful interference to existing terrestrial facilities in the band. Please refer to Annex 1 for further details of this analysis.

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Further, since the start of E-band gateway operations in February 2023 (in the US), Starlink has started operation in E-band in more than 90 gateway sites world-wide and is not aware of any cases of interference.[1]

Starlink routinely coordinates with other operators to assess potential and actual interference and will continue to do so in the UK as others apply for ground infrastructure authorizations. Starlink does not require a standard geographic separation between its gateway earth stations and those of other NGSO systems operating at the same frequencies. Instead, Starlink undertakes a coordination assessment with each operator, typically based on the specific

[1] SpaceX has obtained authorisations to operate in the E-band in a number of countries, including the US, Germany and Spain.

locations and respective operating parameters of each system, to ensure that spectrum is used efficiently and to reduce the possibility of harmful interference.

Additionally, to support the temporary licence application pending future review at WRC-27 (as well as Ofcom's consideration of the use of the E-band more widely), noting the current use of the E-band for Earth Exploration Satellite Services (EESS), SpaceX has prepared a dynamic simulation to demonstrate that the proposed Starlink sites can coexist with EESS. The simulation examples are conservative and the results are not indicative of the maximum number of Earth stations that can coexist with EESS (passive) systems in E-band. A few examples of conservatism included in these simulations are using a high emission level mask compared to actual transmitter emission mask, a high antenna pattern sidelobe envelope compared to actual antenna pattern mask, and conservative EESS protection criteria (RF interference level and the exceedance probability) in RS. 2017. Indeed, RS.2017 appears to be very conservative, including through a protection criterion that dates back to pre-1994. Consequently, SpaceX expresses concern about using this Recommendation, which could create a false impression of spectrum scarcity in E-band where none in fact exists.

Starlink does not perceive or foresee its operations in E-band creating a risk to current or future satellite operators, including in relation to currently planned / pending operations listed on the NGSO Licensing page of the Ofcom website. Additionally, Starlink complies with its obligations under the ITU Radio Regulations, including with respect to GSO networks, and will continue to do so. Therefore, Starlink's requested expanded spectrum access will not interfere with or restrict the competitiveness of other operators.

D4. Competitive Impact

Explain the impact of issuing you a licence (combined with other non-geostationary satellite system licences held or applied for by you) in terms of:

- ***Any risks to competition in the UK. This may refer to the ability to coexist with other non-geostationary satellite systems.***

- ***Benefits for UK customers, end consumers and/or citizens.***

As Ofcom has acknowledged in its CFI – "Expanding Spectrum Access for Satellite Gateways" – services that rely on satellite connectivity are increasingly important to UK consumers and businesses and play a key role in providing broadband to hard-to-reach areas in the UK. Ofcom also recognised that access to the E-band (and Q/V bands) could enable innovation and consumer benefits. Starlink submitted a response to Ofcom and supports the enablement of the Q/V and E bands for satellite gateway use by any operators and timely Ofcom engagement on this issue.

Ofcom has recently awarded a licence to another NGSO operator, which indicates that the landscape in the UK is competitive. Enabling operations in E-band will significantly improve the competitive environment, as it will provide additional flexibility and options to current and future NGSO operators. A competitive landscape with many operators results in innovation and a dynamic market which ultimately benefits UK consumers.

Immediate and temporary access (pending Ofcom's formal policy proposals on the Q/V and E bands) to E-band would help to alleviate Starlink's ongoing spectrum capacity constraints in the UK, particularly in high-demand areas like London, which has been sold out since November 2024. The augmented Starlink system capacity provided by this expanded spectrum access will enhance the services available and the competitive landscape for broadband connectivity in the UK.

Consumer benefit

Starlink anticipates eventually upgrading each of its gateway sites to include E-band capability, which would increase throughput for users in the UK, decrease latency and enhance service availability. The deployment of E-band capable antennas at Morn Hill, Woodwalton, and Wherstead sites, is the first stage of these upgrades and would support increased capacity, decreased latency and improved service quality.

Most notably, these site upgrades will benefit consumers in the UK as the additional network capacity will allow Starlink to serve more residential, business, and government customers. The Starlink service already fills a critical gap in the UK connectivity landscape for previously unserved users and hard-to-reach areas, providing broadband services that are complementary to those of existing operators that are unable to serve such customers. In urban areas, Starlink provides consumer choice and enhances competition where there may otherwise be only one provider. If granted, this request will support serving even more residential, business, and public spaces. In addition, service quality, latency and throughput will also improve for maritime and aeronautical Starlink connectivity routed through UK gateways. Further, Starlink's LEO NGSO-based system provides important redundancy, ensuring that UK consumer, enterprises and governments are not solely reliant on terrestrial connections for broadband access, but can also rely on satellite solutions, especially for applications such as emergency resilience.

Starlink has experienced significant subscriber growth in the UK, [CONFIDENTIAL ✂] indicating strong demand for increased capacity. However, as the existing infrastructure has quickly approached capacity, Starlink has been forced to restrict access for consumers in the UK (e.g. by ending promotions and other growth activities and introducing a one-time congestion fee) and has now marked much of the greater London area and surroundings as "sold out" (i.e. unavailable for new orders). [CONFIDENTIAL ✂]

Service quality would be enhanced by the additional spectrum. The proposed approach will allow Starlink to better utilise its Starlink v2-Mini satellites, which is expected to increase satellite usable capacity by 20%, thus offloading early generation satellites and improving median user speed tests. Starlink's V4 antennas feature dual transmission capability, enabling both Ka and E band transmission. This allows Starlink to immediately implement the proposed approach, with a view to realising consumer benefits quickly, following the granting of a temporary E-band licence.

Coexistence and competition considerations

Starlink is proposing this strategy to efficiently increase capacity and service quality and reduce latency in areas where the existing service is at capacity. The proposed model can be implemented using existing equipment at the current sites with the flick of a switch – i.e. it is

ready go. This is because the current antennae already have the capability to transmit over E-band (in addition to Ka-band) and SpaceX has launched over 2,000 satellites in its second-generation constellation, which include E-band capability. Therefore, if this request is granted, Starlink can immediately utilise the expanded capacity.

Advances in technology, including in relation to modulation and active phased array antennas, have made high-frequency operations not only feasible but highly efficient. Due to its pencil-thin beams and very narrow side-lobes, E-band allows co-existence with other services. In addition, Starlink uses narrow and steerable beams with high minimum elevation angles, which facilitates sharing with other services, reducing the risk of interference and promoting fair competition. In particular, using higher frequencies facilitates narrower beam widths, allowing for more efficient use of spectrum and the ability to reuse frequencies more effectively, and more precise beamforming, leading to less signal spillover into adjacent spectrum bands and reducing interference with other services.

Starlink's proposal to expand to E-band operations represents an option that efficiently uses spectrum and existing infrastructure to contribute to alleviation of capacity constraints in the UK. Potential alternative approaches (e.g. additional Ka-band spectrum allocations and establishing additional Ka-band gateway sites) would require significant time and investment in additional sites and equipment. These alternatives may also necessitate more Ka-band spectrum coordination and further spectrum allocations in already congested bands. Therefore, realising the benefits outlined above would not be as efficient or effective, nor address the current constraints in a timely manner.

In relation to broader benefits to the UK, Starlink's investment in local infrastructure and reliance on UK vendors for equipment supports local economic growth and job creation, which can mitigate competitive risks. Additionally, allowing companies to access these higher frequency bands encourages investment in new satellite technologies, driving industry-wide improvements in spectrum utilisation. In addition to working with local site hosts and fibre providers, SpaceX is also partnering with UK's Filtronics to provide E-band capable solid-state power amplifiers for ground equipment. This is an example of the new market opportunities that are created for equipment manufacturers due to Starlink's expanded use of high-frequency bands. This is in addition to the obvious benefits of Starlink as regards infrastructure redundancy, consumer choice and competition and increased access to high-speed, low-latency broadband services, as well as supporting high-speed and secure broadband services that are essential for government and other sensitive communications, which require significantly more bandwidth than lower frequency bands can offer.

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Annex 1

Initial Interference Analyses for Starlink Earth Stations and Existing Ofcom-Coordinated E-Band Links

Overview

Starlink conducted interference analyses using the E-band link registration information within the Ofcom Spectrum Information Portal to assess potential for harmful interference from the three Starlink earth stations listed below to each existing terrestrial link. Starlink has documented the assumptions, methodologies, and results of Starlink's interference analysis below and in the attachments provided with this document. Starlink conservative analysis shows that the three Starlink earth stations listed below will not exceed or even get close to a harmful interference threshold of -6 dB I/N at any of the existing terrestrial links.

Starlink's E-band gateway earth stations will use high-gain, narrow, directional beams, high minimum elevation angles of 25 degrees, and low sidelobes. These narrow, upward-facing links create small, predictable coordination zones that facilitate coexistence with incumbent and future fixed links through minimal angular or physical separation.[2] Starlink has completed an interference analysis based on accepted, conservative international methodologies to demonstrate that E-band use by these satellite gateway earth stations is not predicted to cause harmful interference to existing terrestrial facilities in the band. Nor will SpaceX's E-band operations preclude future deployments in E-band, which can be readily managed through direct coordination and common interference mitigation techniques.

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[2] Other factors, such as terrain and clutter, even further reduce the potential of harmful interference from satellite earth stations in the 70/80 GHz band.

Annex 2

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