Annex to satellite (earth station network) radio licence application form - OfW602

Applicant: Rivada Space Networks GmbH

Contents

1. Introduction

This annex to Rivada Space Networks GmbH's application for a *satellite earth station network license for NGSO use,* answers the questions D1, D2 and D3 in the application form (OfW602). In the second chapter of this document, we describe the satellite system and the services Rivada Space Networks GmbH will be offering. The third chapter contains the results of the simulations we calculated to assess how coexistence with the existing NGSO systems may be realized. In chapter four we discuss the available options to assure coexistence also with future NGSO systems that will be providing their services in the UK. In the fifth chapter the optional question D3 is answered with an assessment of the expected impacts on competition in the UK market and a qualitative analysis of the effects on the UK economy as well as on citizens and businesses. And the final chapter explains how Rivada Space Networks will comply with the new licence conditions Ofcom has recently proposed and consulted on.

Rivada Space Networks GmbH applies for a licence to use all of the available spectrum in the Ka-band, which has been allocated to satellite services as specified in Ofcom's *Licensing guidance*[1] *for non-geostationary satellite earth stations* (p. 6, section 1.19):

Earth to space (Uplink)
27.5 – 27.8185 GHz
28.4545 – 28.8265 GHz
29.5 – 30 GHz

In those frequency ranges we are planning to provide fixed satellite services and connectivity to earth stations in motion (ESIM). With the regulatory conditions for the operation of ESIMs in the Ka-band on the agenda of this year's World Radio Conference (WRC-23), Rivada Space Networks is looking forward to the possible extension of the NGSO network licence in 2024, as outlined by Ofcom in the recent public consultation[2] on new licence conditions. If such an extension would be implemented, we will await Ofcom guidelines on how to extend the scope of any licence we may have obtained in the meantime.

[1] Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0021/229224/ngso-guidance.pdf
[2] Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0024/261267/esn-licence-condoc.pdf , p. 6: "Pending the outcome of WRC-23 deliberations, we plan to consider expanding our authorisations for terminals connecting to both GSO and NGSO systems to include these frequencies next year (2024)."

2. The Rivada Space Networks Satellite System

Rivada Space Networks is operating on the 3ECOM-1 and 3ECOM-3 ITU filings, submitted by Liechtenstein in 2014. On 27 February 2023 the Office for Communications (AK) of Liechtenstein has decided[3] to grant Rivada AG – a Liechtenstein-based wholly owned subsidiary of Rivada Space Networks GmbH – the authorization to carry out international coordination as delegated operator of the AK. In the same decision the AK has declared its approval of the frequency usage agreement between Rivada AG and Rivada Space Networks GmbH:

> *"5. Pursuant to Article 97 IFV, the Office for Communications shall approve the transfer of the rights of use for all frequencies covered by the allocation in question under item 2 in favor of Rivada Space Networks GmbH in order to enable the latter to operate the planned Low Earth Orbit (LEO) satellite system and to offer satellite services via this satellite system on a permanent basis."*

The Office of Communication also declares in the decision, that its provisional allocation of the frequency usage rights associated with the 3ECOM-1 and 3ECOM-3 filings to Trion Space AG (by order of the AK dated 8 January 2018 and as amended by an order dated 4 March 2021) was revoked with immediate effect by order[4] AZ 735.3 /2023-12287. Consistent with this, AK has sent a letter to the ITU on the 1st of February 2023 changing the operating agency for the 3ECOM-1 and 3ECOM-3 filings fromTrion Space to Rivada AG.

Rivada Space Networks will provide enterprise grade IP transport capacity on a global scale. By July 2026 the first 300 satellites will be launched to 12 polar orbits. To this end, Rivada Space Networks GmbH has in February 2023 concluded commercial contracts[5] with Tyvak Nano-Satellite Systems Inc. (wholly owned by Terran Orbital) for the manufacturing and SpaceX for the launching of the first 300 satellites. Those two contracts as well as clear evidence of funding have been substantial inputs to Liechtenstein's submission to the Radio Regulations Board (RRB) of the ITU. In this submission the Office for Communications of Liechtenstein requested the RRB to waive the first milestones for the 3ECOM-1 and 3ECOM-3 filings under the terms of Resolve 12 of Resolution 35, which was adopted by the World Radio Conference in 2019. With the favorable decision[6] on the request taken by the RRB in July the requirement to deploy a minimum of 10% of the respective constellations in 2023 has been waived. Rivada Space Networks GmbH is now fully focused and well on track to deliver Milestone 2, which requires 144 satellites (or 50% of the constellation) in orbit on 10 June 2026 for the 3ECOM-1 filing and the same number of satellites in orbit on 18 September 2026 for the 3ECOM-3 filing.

Flying at an altitude of 1,050 kilometers our first 300 satellites will provide global coverage, including the high seas and polar regions. The constellation can subsequently be scaled up to 600 satellites (576 active and 24 in-orbit spares) by July 2028.

---

[3] Order issued by the Office for Communications in the administrative matter under file number 735.3 / 2023-12288. Decided on 27 February 2023. Unofficial translation into English. Source: https://archiv.llv.li/files/ak/20230227_ak_rivada-ag_verfugung-vorlaufige-frequenzzuteilung_en-us-preliminary-frequency-allocation-order-ak-web.pdf

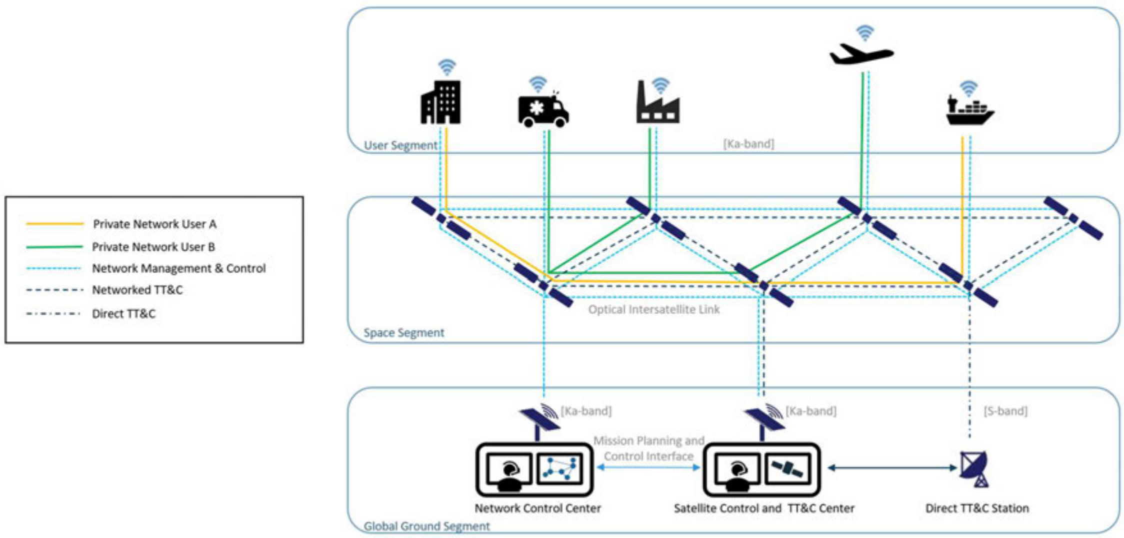
[4] Order issued by the Office for Communications in the administrative matter under file number 725.3 / 2023-12287. Decided on 27. February 2023. Available in German only. Source: https://archiv.llv.li/files/ak/20230227_ak_trion-space-ag_verfugung-widerruf-vorlaufige-zuteilung-ak-web.pdf

[5] See press release from 22 February 2023: https://rivadaspace.com/news/rivada-space-networks-signs-manufacturing-contract-for-unique-data-connectivity-satellite-constellations-in-low-earth-orbit-leo

[6] Source: https://www.itu.int/dms_pub/itu-r/md/23/rrb23.2/c/R23-RRB23.2-C-0023!!PDF-E.pdf [Item 9; ITU TIES account required for access to the document]

Its unique and innovative design sets our constellation apart from that of any other satellite operator. . We are providing an MPLS-based backbone network in space that operates completely independent of third party infrastructure. Each satellite is equipped with four optical intersatellite laser links and a regenerative payload, i.e. onboard routers. This allows Rivada Space Networks to optimally route the traffic of our customers around the world. Our mesh-network, which we like to call the “OuterNET”, eliminates the need to bring the traffic back down to Earth for Internet connectivity. It is effectively a private network in space, assuring the highest possible level of security.

Rivada Space Networks Network Diagram



It is anticipated that the Satellite Control Center will be located in Germany. It will be responsible for the management of the satellites, keeping them on the defined orbits and ensuring their safety. During the launch and early orbit phase (LEOP) the satellites will be controlled over a direct link in the S-band frequency range. This direct control channel will stay available for non-nominal operations, for example to conduct special maneuvers. During nominal operations the entire constellation will be controlled via an uplink in Ka-band to one satellite which will then propagate the control commands across the constellation using the intersatellite laser links. This is what we labelled “networked TT&C” in the Network Diagram above. The Network Control Center (NCC) is in charge of the control and orchestration of the entire network. It generates configurations based on the different capabilities of the network elements, while respecting the regulatory limits and fulfilling the requests of the customers. The configuration of the network, including the power levels of and the radio frequencies used by the user terminals, is done in real time to always provide the optimal level of service to our users. The same functionality also allows to authorize and supervise the user terminals from the network level. Fulfilling the respective regulatory obligations, the NCC may disable the transmission of individual terminals. Rivada is currently in the process of preparing a process to decide from which locations to operate its earth stations with independent centralized control and monitoring functionality .

The user requests network connectivity, which can be established over a point to point or a multipoint to multipoint path, and the Network Control Center will configure all the elements of the network to setup a private network at the data link layer (layer 2 in the OSI model) between the endpoints requested by a given customer.

Partnering with Aalyria[7] – a Google spin-out – will allow us to use the latest available technology in Software Defined Networking (SDN) to control the entire constellation as well as all the user terminals centralized and in real-time from the Network and Satellite Control Centers. This implementation of system control over the flow of network traffic, the power levels of the transmissions from each network element (satellites and user terminals) and the radio frequencies used will assure compliant operation of our system within the limits prescribed by the applicable rules and regulations. Specifically, we will meet the requirements specified in Article 22 of the ITU Radio Regulations and in the UK Interference Requirement 2077[8].

It is important to note that Rivada Space Networks GmbH will provide its services at the wholesale level. Service providers, resellers and system integrators will build tailormade solutions on top of the MPLS-based transport capacity we provide and market their own services to end-users. The end-users are expected to be large enterprises and governments who require low latency, high data rates and exceptional security. Consequently, we are not planning to provide Internet access services. Should an end customer require connectivity to the public Internet, that may be realized by the service provider, but it is not the application which has been driving Rivada Space Networks' system design. The market segments we expect to be serving are:

- Secure and resilient Government communications
- Low latency enterprise networking
- Seamless global connectivity for aviation and maritime
- Backhaul services for telecommunication network operators
- Future use cases which cannot be realized on the current generation of networks

More information can be found on our webpage: https://rivadaspace.com/solutions

[7] Source: https://rivadaspace.com/news/rivada-aalyria
[8] Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0029/84683/ir2077.pdf

3. Coexistence with existing systems (answer to question D1)

Ofcom instructions in application form OfW602 (p. 2): "This is a multipart question for explaining how your proposed non-geostationary earth station(s) ("User terminals") 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."

At the time of our application the existing NGSO-systems licensed in the UK are:

Existing NGSO network earth station licences

Licensee	Licence number	Date first issued
Mangata Edge Ltd (PDF, 1.6 MB)	1309175	22 March 2023
Telesat LEO Inc (PDF, 253.5 KB)	1297041	14 November 2022
Starlink Internet Services Limited (PDF, 253.8 KB)	1239247	16 November 2020
Network Access Associates Ltd (PDF, 257.8 KB)	1102679	9 November 2016

Source: https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/satellite-earth/non-geo-fss

The impact of potential interference from Rivada Space Networks NGSO satellite system on the systems of the existing licensees was analyzed and is shown below. The cumulative distribution function of C/N and C/(N+I) was determined for each victim by simulating the systems for a given duration. In the figures below, C/N represents the performance of the link without the existence of Rivada Space Networks system and C/(N+I) represents the performance of the link with the existence of Rivada Space Networks system. From the C/N and C/(N+I) data, the average spectral efficiency and link unavailability are calculated based on an assumed C/N target of -5 dB. Consequently, the degradation in those two parameters is given for uplink and downlink separately. It is assumed that ground terminals are always collocated and operating at the same frequencies. In all simulations, ITU-R P.618 and ITU-R P.676 are used to model propagation. Taking into account the rain attenuation, a complete correlation between the victim and the interfering links is always considered. Random tracking strategy was chosen for all systems.

Results indicate that even without the use of mitigation techniques and based on the operational characteristics given below, impact is minimal and coexistence is possible.

In Ka-band, Rivada Space Networks is also required to coordinate its system with the specific Earth stations under No. 9.7B. Rivada Space Networks will operate in accordance with agreed coordination terms to protect specific co-frequency Earth stations registered with the ITU and located in the UK.

Rivada Space Networks system characteristics

Table 1 Rivada Space Networks orbital parameters

Parameter	**Value**	**Unit**
Number of planes	24	
Satellites per plane	24	
Apogee altitude	1050	km
Perigee altitude	1050	km
Inclination	89	deg

Table 2 Rivada Space Networks generic operational parameters

Parameter	**Value**	**Unit**
GSO exclusion angle	4	deg
Minimum elevation angle	10	deg
E/S antenna Tx gain	49	dBi
E/S antenna pattern	Rec. ITU-R S.1428	
Satellite antenna Tx gain	30	dBi
Satellite antenna pattern	Rec. ITU-R S.1528 (Ln=-20)	
Uplink power spectral density	-13	dBW/MHz
Power Flux Density on ground	-123	dBW/m2/MHz

3.1. Mangata Edge Ltd

Table 3 Mangata orbital parameters

Set	Parameter	Value	Unit
1	Number of planes	27	
	Satellites per plane	21	
	Apogee altitude	6400	km
	Perigee altitude	6400	km
	Inclination	45, 50, 52.5	deg
2	Number of planes	32	
	Satellites per plane	7	
	Apogee altitude	11585, 9800, 9000, 11024	km
	Perigee altitude	1215, 3000, 3800, 1776	km
	Inclination	63.4	deg

Table 4 Mangata operational parameters

Parameter	Value	Unit
GSO exclusion angle	3	deg.
Minimum elevation angle	15	deg.
E/S antenna Tx gain	43.6	dBi
E/S antenna Rx gain	40.2	dBi
E/S antenna Tx pattern	Rec. ITU-R S.465-5	
E/S antenna Rx pattern	Rec. ITU-R S.580-6	
E/S antenna receive noise temperature	290	K
Satellite antenna Tx gain	43.2	dBi
Satellite antenna Rx gain	46.7	dBi
Satellite antenna pattern	Rec. ITU-R S.1528 (Ln=-25)	
Satellite antenna receive noise temperature	600	K
Uplink max. power spectral density	-70	dBW/Hz
Uplink min. power spectral density	-80.1	dBW/Hz
Downlink max. power spectral density	-87.2	dBW/Hz
Downlink min. power spectral density	-107.2	dBW/Hz

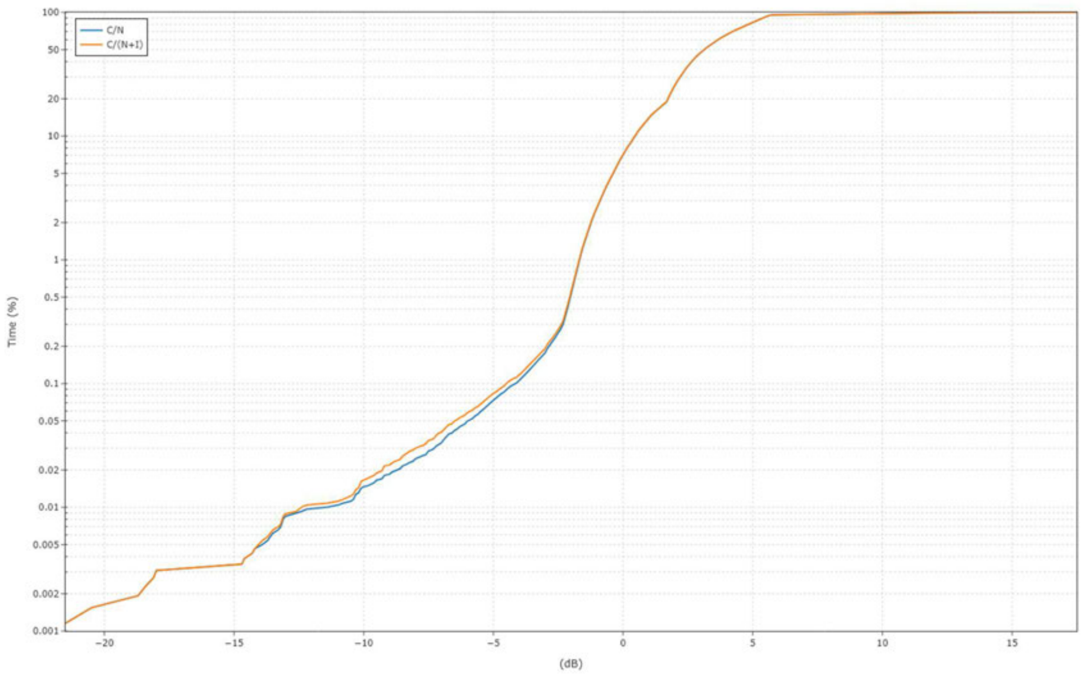


Figure 1 Mangata downlink analysis result

Table 5 Degradation Mangata downlink performance due to potential interference

Mangata Downlink	**Value**	**Unit**
Increase in unavailability	0.01	%
Decrease in average spectral efficiency	0.072	%

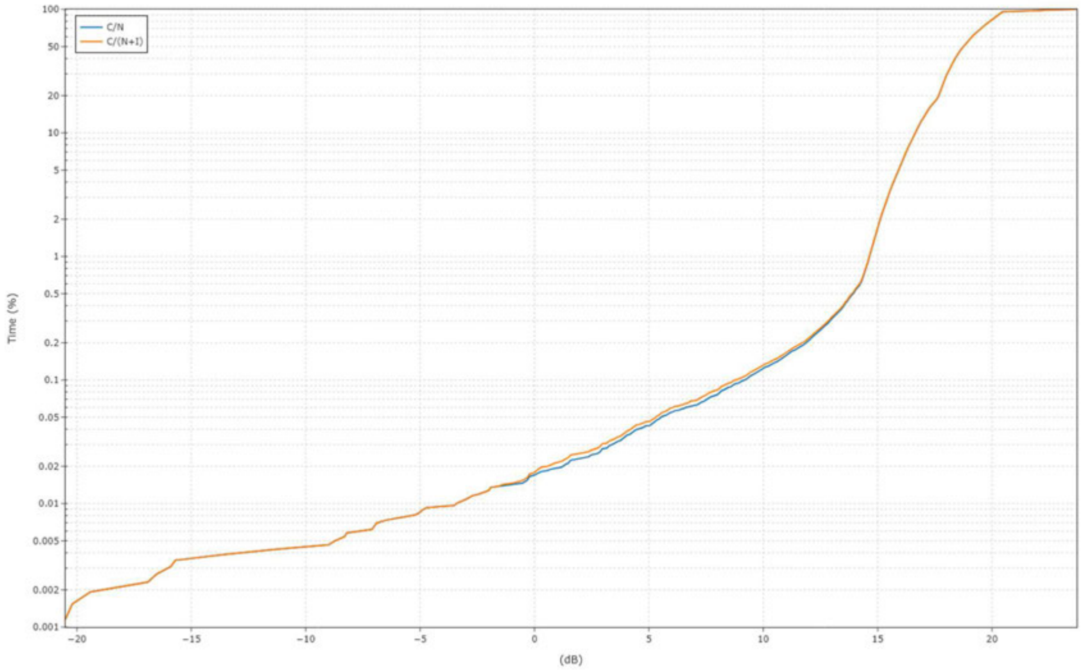


Figure 2 Mangata uplink analysis result

Table 6 Degradation of Mangata uplink performance due to potential interference

Mangata Uplink	**Value**	**Unit**
Increase in unavailability	0.072	%
Decrease in average spectral efficiency	0.03	%

3.2. Telesat LEO Inc.

Table 7 Telesat orbital parameters

Set	Parameter	Value	Unit
1	Number of planes	6	
	Satellites per plane	13	
	Apogee altitude	1015	km
	Perigee altitude	1015	km
	Inclination	98.98	deg
2	Number of planes	20	
	Satellites per plane	11	
	Apogee altitude	1325	km
	Perigee altitude	1325	km
	Inclination	50.88	deg

Table 8 Telesat operational parameters

Parameter	Value	Unit
GSO exclusion angle	4.5	deg
Minimum elevation angle	10	deg
E/S antenna Tx gain	40	dBi
E/S antenna Rx gain	36.4	dBi
E/S antenna pattern	Rec. ITU-R S.580-6	
E/S antenna receive noise temperature	275	K
Satellite antenna Tx gain	30.8	dBi
Satellite antenna Rx gain	30.8	dBi
Satellite antenna pattern	Rec. ITU-R S.1528-1 (Ln=-20)	
Satellite antenna receive noise temperature	526	K
Power range at e/s antenna flange	-23.8 .. -13.4	dBW/MHz
pfd at the satellite	-96.7	dBW/m2/MHz
Power range at satellite antenna flange	-30.7 .. -20.3	dBW/MHz
pfd on ground	-131	dBW/m2/MHz

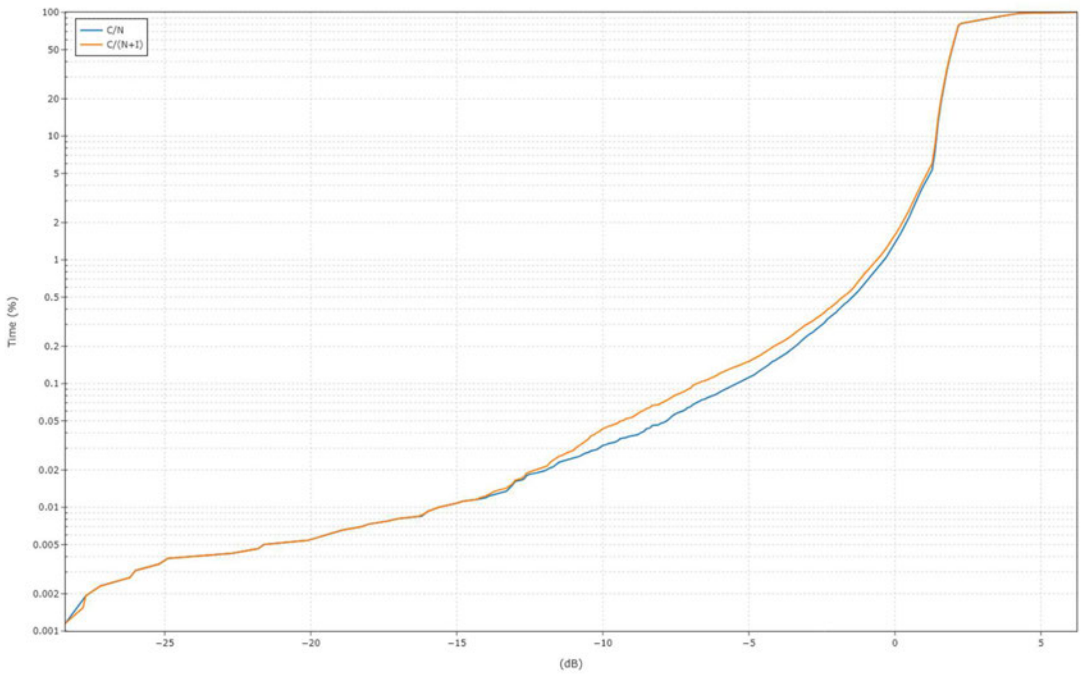


Figure 3 Telesat downlink analysis result

Table 9 Degradation of Telesat downlink performance due to potential interference

Telesat Downlink	Value	Unit
Increase in unavailability	0.04	%
Decrease in average spectral efficiency	0.31	%

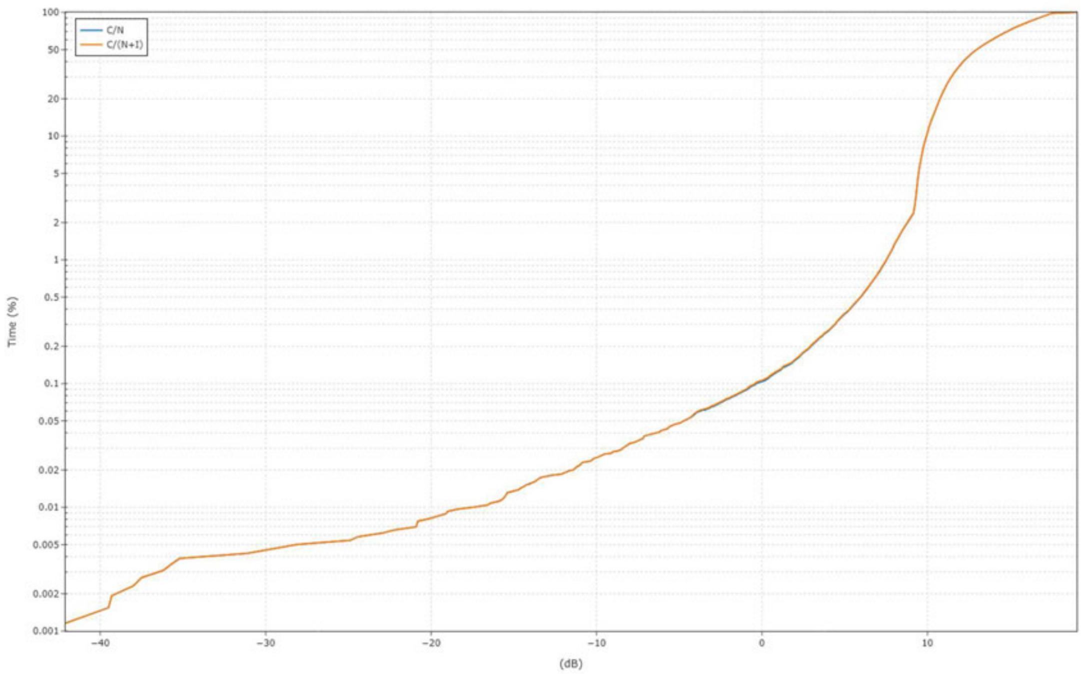


Figure 4 Telesat uplink analysis result

Table 10 Degradation of Telesat uplink performance due to potential interference

Telesat Uplink	**Value**	**Unit**
Increase in unavailability	0	%
Decrease in average spectral efficiency	0.021	%

3.3. Starlink Internet Services Limited

Table 11 Starlink orbital parameters

Set	Parameter	Value	Unit
1	Number of planes	72	
	Satellites per plane	22	
	Apogee altitude	540	km
	Perigee altitude	540	km
	Inclination	53.2	deg
2	Number of planes	72	
	Satellites per plane	22	
	Apogee altitude	550	km
	Perigee altitude	550	km
	Inclination	53	deg
3	Number of planes	10	
	Satellites per plane	43, 58	
	Apogee altitude	560	km
	Perigee altitude	560	km
	Inclination	97.6	deg
3	Number of planes	36	
	Satellites per plane	20	
	Apogee altitude	570	km
	Perigee altitude	570	km
	Inclination	70	deg

Table 12 Starlink operational parameters

Parameter	Value	Unit
GSO exclusion angle	18	Deg
Minimum elevation angle	25	Deg
E/S antenna Tx gain	49.5	dBi
E/S antenna Rx gain	46.9	dBi
E/S antenna pattern	Rec. ITU-R S.580-6	
E/S antenna receive noise temperature	200	K
Satellite antenna Tx gain	34.5	dBi
Satellite antenna Rx gain	38.5	dBi
Satellite antenna pattern	Rec. ITU-R S.1528-1 (Ln=-20)	
Satellite antenna receive noise temperature	500	K
Power at e/s antenna flange	-18.85	dBW/MHz
pfd on ground	-126.3	dBW/m2/MHz

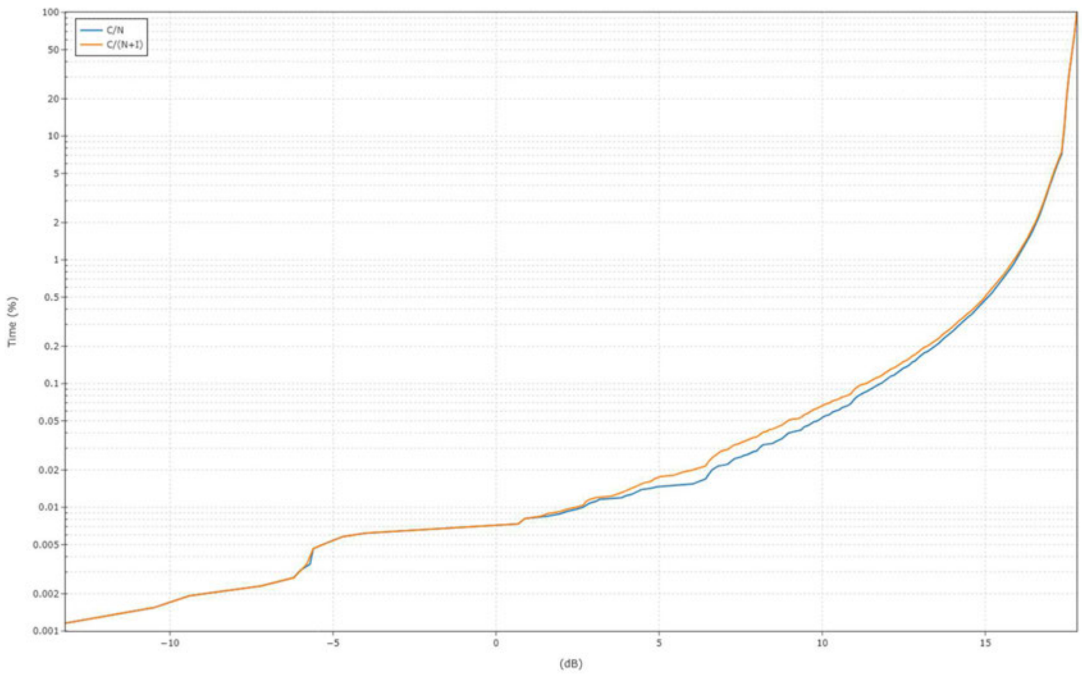


Figure 5 Starlink downlink analysis result

Table 13 Degradation of Starlink downlink performance due to potential interference

Starlink Downlink	**Value**	**Unit**
Increase in unavailability	0.0	%
Decrease in average spectral efficiency	0.037	%

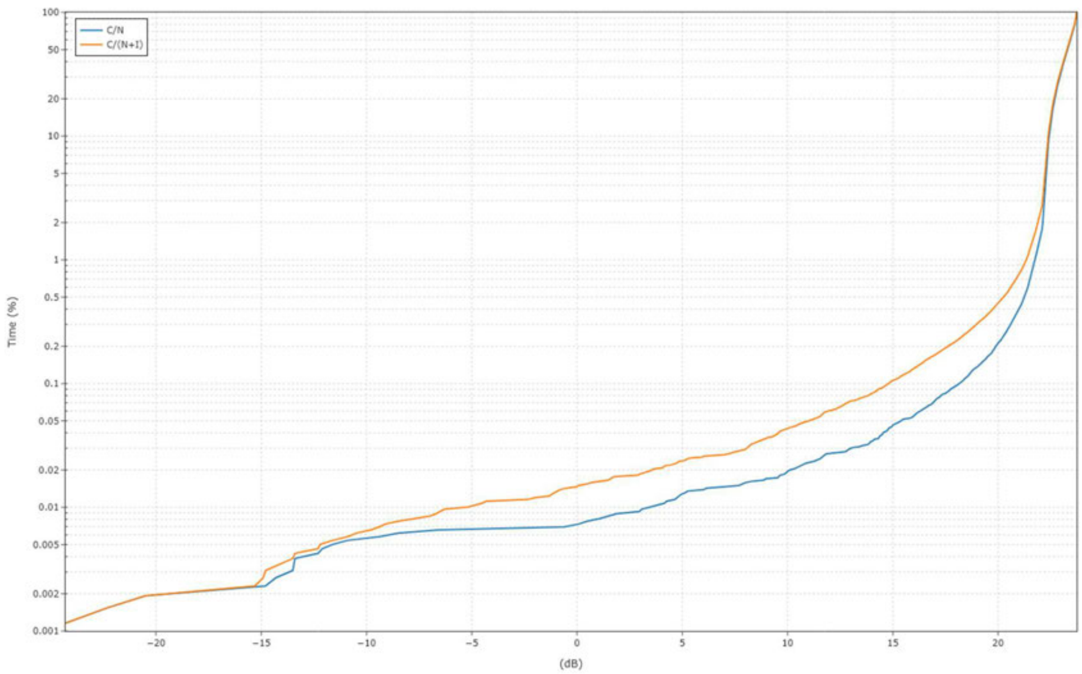


Figure 6 Starlink uplink analysis result

Table 14 Degradation of Starlink uplink performance due to potential interference

Starlink Uplink	**Value**	**Unit**
Increase in unavailability	0.003	%
Decrease in average spectral efficiency	0.23	%

3.4. Network Access Associates Ltd

Table 15 Network Access Associates Ltd orbital parameters

Parameter	Value	Unit
Number of planes	18	
Satellites per plane	43	
Apogee altitude	1200	km
Perigee altitude	1200	km
Inclination	87.9	deg

Table 16 Network Access Associates Ltd operational parameters

Parameter	Value	Unit
GSO exclusion angle	6	deg
Minimum elevation angle	5	deg
E/S antenna Tx gain	58	dBi
E/S antenna Rx gain	54.6	dBi
E/S antenna pattern	Rec. ITU-R S.580-6	
E/S antenna receive noise temperature	240	K
Satellite antenna Tx gain	34.5	dBi
Satellite antenna Rx gain	38.2	dBi
Satellite antenna pattern	Rec. ITU-R S.1528-1 (Ln=-20)	
Satellite antenna receive noise temperature	520	K
pfd at the satellite	-101	dBW/m2/MHz
pfd on ground	-131.8	dBW/m2/MHz

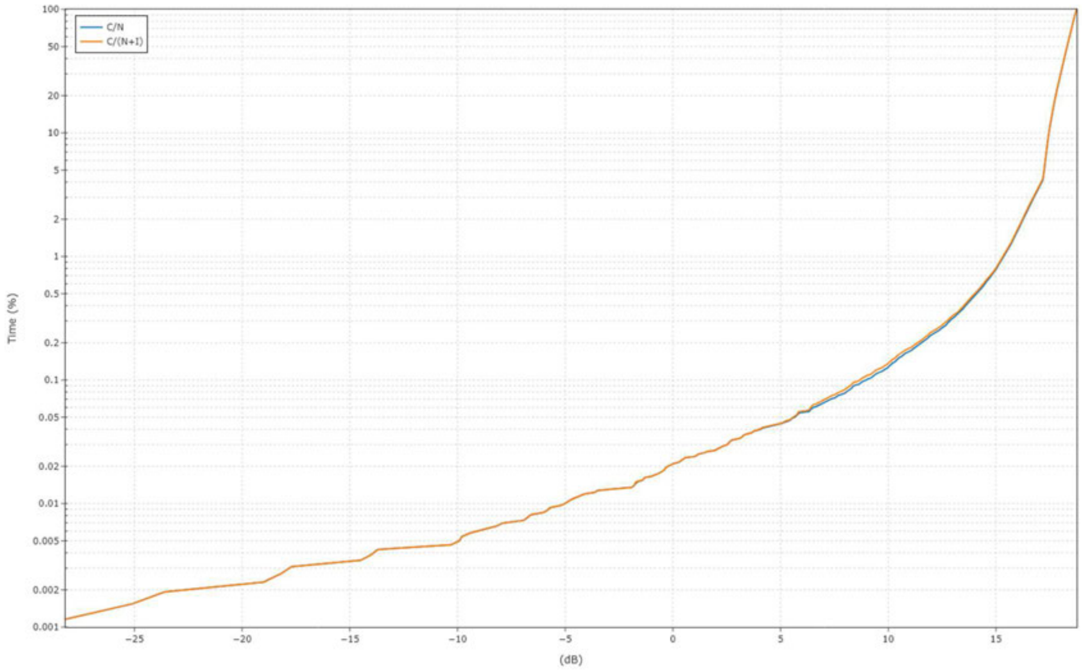


Figure 7 Network Access Associates Ltd downlink analysis result

Table 17 Degradation of Network Access Associates downlink performance due to potential interference

Network Access Associates Ltd Downlink	**Value**	**Unit**
Increase in unavailability	0.0	%
Decrease in average spectral efficiency	0.05	%

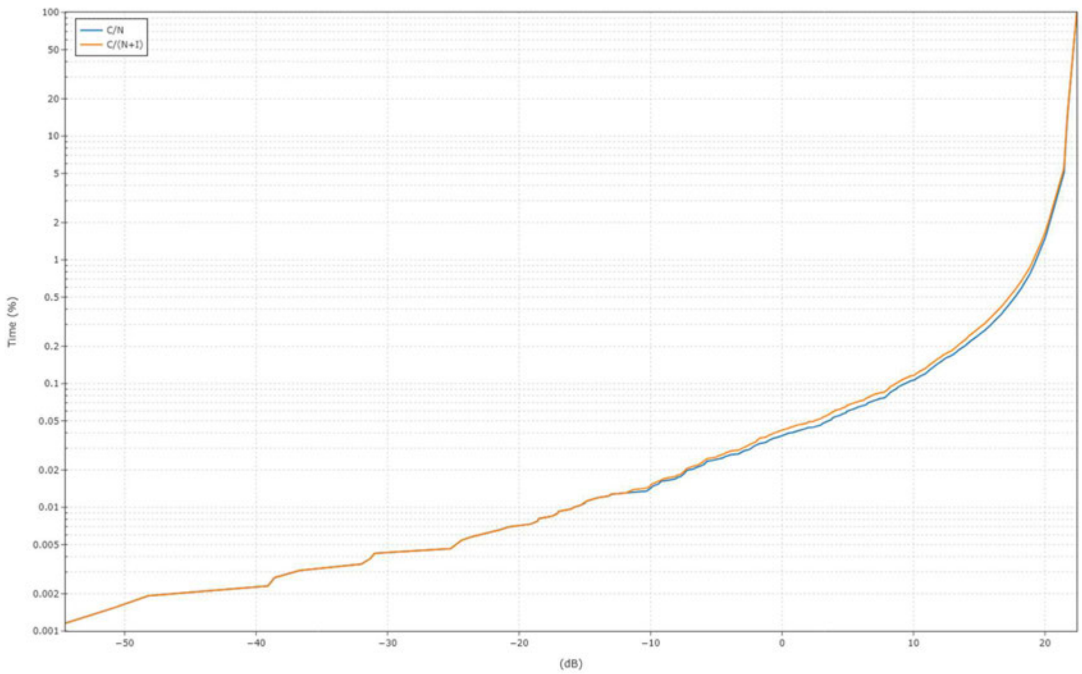


Figure 8 Network Access Associates Ltd uplink analysis result

Table 18 Degradation of Telesat uplink performance due to potential interference

Network Access Associates Ltd Uplink	**Value**	**Unit**
Increase in unavailability	0.001	%
Decrease in average spectral efficiency	0.24	%

4. Coexistence with future systems (answer to question D2)

Ofcom instructions in application form OfW602 (p. 3): You need to state what flexibility your User terminals 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 User terminals.

Rivada Space Networks implements optical links between the satellites which gives flexibility in choosing the location of a gateway if needed although Rivada Space Networks does not rely on gateways. It is possible to continuously monitor and adjust power levels, carrier bandwidth, and beam positions, which allows to greatly reduce the possibility of inline events. Defining sufficient avoidance angles during coordination will provide opportunity for coexistence of co-frequency systems, also with operators entering the UK market in the future.

The results of our analysis for coexistence with existing NGSO systems in the UK (as shown in the above section) allow the conclusion that Rivada Space Networks will be able to find solutions to exist with future NGSO systems. We expect all stakeholders to be technically capable to apply the standard mitigation methods, such as (1) Lookaside, (2) Avoidance of overlapping frequency bands and (3) Use of opposite polarization. The negotiation of the specific methods and parameters will be the subject of coordination negotiations.

Rivada Space Networks is optimistic, that solutions based on the Lookaside method will be negotiable with future NGSO systems entering the UK market. This assessment is based on our review of existing ITU filings which allows the assumption, that future NGSO systems will have alternative satellites available in sufficient numbers to apply that mitigation technique, at least in the foreseeable future. Rivada Space Networks is prepared to coordinate in good faith to implement other mitigation techniques where feasible, to accommodate future systems.

5. Competitive impacts (answer to optional question D3)

Ofcom Instructions in application form OfW602 (p. 3): This is a multipart, optional question for explaining 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.

Once operational, Rivada Space Networks GmbH's Low Earth Orbit (LEO) satellite constellation will deliver significant quality upgrades in the global market for end-to-end enterprise-grade IP connectivity. Authorizing Rivada Space Networks to operate its satellite network in the UK will add unique options to the mix of satellite services available to consumers and businesses in the UK. The Rivada Space Networks constellation is unique in its design, which does not rely on bringing the data traffic back down to earth as soon as possible. Instead we utilize optical inter-satellite laser links to route our customers' traffic from satellite to satellite, along the most efficient path across the constellation to its designated endpoints. This innovative network architecture minimizes roundtrip times of data packages while maximizing the security of the connection. With no third party networks involved in establishing an IP-based connection between two points anywhere on the planet, the number of infliction points for manipulation or interception of traffic is as low as it can be. Consequently, RSN trusts it has unique selling points that will intensify competition in the market for enterprise-grade connectivity services in the UK.

Satellite communications is a growing market with rapid technological innovation. A study by VVA and LS Telecom, which was mandated and published in March 2023 by the Global Satellite Operators Association (GSOA), found "With the deployment of new high-capacity satellite constellations and recent technology advances, satcoms is a vibrant and competitive market[9]". This overall positive assessment of the effects of rapid technological innovation and increasing market dynamics with rising numbers of operational constellations is also reflected in the recent public consultation of proposed modifications to the Satellite Earth Station Network licences, where Ofcom states:

> *"1.3 These NGSO systems have the potential to offer higher capacity and lower latency broadband services, which can serve larger numbers of customers at higher speeds. We want to encourage as many of these NGSO services as possible for the benefit of UK consumers and businesses.[10]"*

In November 2022 Ofcom has stated in its Space spectrum strategy:

> *"1.2 Growth in the space sector has the potential to help promote innovation and growth in the UK economy as a whole. Achieving these benefits requires appropriate access to, and efficient use of, radio spectrum.[11]"*

In our above answers to questions D1 and D2 we have demonstrated that allowing Rivada Space Networks GmbH's satellite system to operate in the UK can be expected to introduce only negligible

---

[9] "The Socio-Economic Value of Satellite Communications" – Study for GSOA by Valdani Vicari & Associati and LS Telecom, March 2023. Source: https://gsoasatellite.com/wp-content/uploads/VVA_LSTelcom_Socio-Economic-Value-of-Satcom_24032023.pdf

[10] "Satellite Earth Station Network licences – Proposal to enable NGSO maritime services and adopt new conditions on coexistence" – Ofcom consultation document, May 2023. Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0024/261267/esn-licence-condoc.pdf

[11] "Space spectrum strategy" – Ofcom statement, November 2022. Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0023/247181/statement-space-spectrum-strategy.pdf

interference on existing NGSO systems and that coexistence will also be feasible with future NGSO systems. It is therefore safe to assume that the UK economy as a whole will benefit from an additional player in the market. The most direct beneficiaries will be UK businesses in demand of high quality IP transport services, which come with an added layer of security and the possibility to connect to endpoints all around the globe. Utilizing our satellite network will allow those businesses to build and deploy new networking solutions and to introduce new services of their own, which cannot be realized on the infrastructure available today. Creating these new business opportunities will also benefit the labor force in the UK by creating new jobs and revenue streams.

This positive impact assessment corresponds with the conclusions of the Competition and Markets Authority (CMA) after extensively investigating the acquisition of Inmarsat by Viasat. In its Summary[12] the CMA states:

> *"Satellite connectivity is a dynamic sector, with supply expected to expand rapidly in the next few years. The sector has recently seen, and is likely to continue to see, disruptive entry by new players with innovative technologies and substantial resources, while established providers are also responding to these threats and opportunities in various ways. This is affecting conditions of competition across all services provided using satellite connectivity […]"*

---

[12] Summary of Final report. Published in May 2023 by the Competition and Markets Authority. Source: https://assets.publishing.service.gov.uk/media/645a044cc6e8970012a0fac9/Viasat_Inmasat_Summary_.pdf

6. Compliance with additional conditions

6.1. Protection of fixed links

To protect fixed links, the ITU has established power flux density limits for NGSO systems in Article 21 of the Radio Regulations. The applicable limits in any 1 MHz band of 17.7 to 19.3 GHz are as follows:

- -115 - X dB(W/m2) for angles of arrival between 0 and 5 degrees above the horizontal plane.
- -115 - X + ((10 + X) / 20)(δ - 5) dB(W/m2) for angles of arrival (δ) between 5 and 25 degrees above the horizontal plane.
- -105 dB(W/m2) for angles of arrival between 25 and 90 degrees above the horizontal plane.

where X is defined as a function of the number, N, of satellites in the NGSO satellite constellation, as follows:

X = 0	dB	for	N ≤ 50
X = (5/119) (N - 50)	dB	for	50 < N ≤ 288
X = (1/69) (N + 402)	dB	for	N > 288

The limits in any 1 MHz band of 19.3 to 19.7 GHz band are:

- -115 dB(W/m2) for angles of arrival between 0 and 5 degrees above the horizontal plane.
- -115 + 0.5(δ - 5) dB(W/m2) for angles of arrival (δ) between 5 and 25 degrees above the horizontal plane.
- -105 dB(W/m2) for angles of arrival between 25 and 90 degrees above the horizontal plane.

Our system complies with the power flux density limitations given above for all angles of arrival above the horizontal plane. It is also possible to dynamically adjust the satellite downlink power, as necessary, to protect fixed links in the 17.7-19.7 GHz band.

6.2. Protection of radio astronomy

Ofcom has imposed conditions on certain parts of the Ku band to protect radio astronomy from potential interference from NGSO satellite systems operating in frequencies adjacent to those allocated to radio astronomy. Our system will not operate in the Ku band. Therefore, radio astronomy is protected from harmful interference from our system in the bands 14.25-14.5 GHz and 10.6-10.7 GHz.

6.3. Protection of GSO services

Our system fully complies with the equivalent power flux-density (epfd) limits in Article 22 of the ITU Radio Regulations. With the implementation of GSO arc avoidance angle, our earth stations will not transmit if the minimum topocentric angle measured from the earth station between the interfering non-GSO space station and any point in the visible GSO arc is below a certain value. In addition, our satellite antennas are designed to suppress off-axis transmissions sufficiently to comply with the limits while observing the GSO arc avoidance angle to transmit. Compliance with the epfd limits has already been demonstrated by the publication of ITU filings 3ECOM-1 and 3ECOM-3 with favorable findings. Therefore, GSO services are adequately protected in the Ka band to which these limits apply.

Resolution 76 of the ITU Radio Regulations limits aggregate epfd levels produced by all operating co-frequency NGSO FSS systems. Rivada Space Networks will cooperate with other NGSO FSS operators to ensure compliance with the applicable limits.

In frequency bands to which epfd limits do not apply, Rivada Space Networks coordinates with GSO satellite operators in good faith and in accordance with the ITU Radio Regulations.